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Water-Supply and Irrigation Paper No. 80 Series M, General Hydrographic Investigations, 4

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

J. L. LUDLOW, C. E. M. S.
M. AM. SOC. C. E.
WINSTON, N. C.

THE RELATION OF RAINFALL TO RUN-OFF

BY

GEORGE W. RAFTER

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PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

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WS 71. Irrigation systems of Texas, by T. U. Taylor. 1902. 137 pp., 9 pls.
WS 74. Water resources of the State of Colorado, by A. L. Fellows. 1902. 151 pp., 14 pls.

The following papers also relate especially to irrigation: Irrigation in India, by H. M. Wilson, in Twelfth Annual, Part II; two papers on irrigation engineering, by H. M. Wilson, in Thirteenth Annual, Part III.

Series J—Water Storage.

WS 33. Storage of water on Gila River, Arizona, by J. B. Lippincott. 1900. 98 pp., 33 pls.
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WS 46. Physical characteristics of Kern River, California, by F. H. Olmsted, and Reconnaissanc of Yuba River, California, by Marsden Manson. 1901. 57 pp., 8 pls.
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WS 68. Water storage in Truckee Basin, California-Nevada, by L. H. Taylor. 1902. 90 pp., 8 pl
WS 73. Water storage on Salt River, Arizona, by A. P. Davis. 1902. 54 pp., 25 pls.

The following paper also should be noted under this heading: Reservoirs for irrigation, b J. D. Schuyler, in Eighteenth Annual, Part IV.

Series K—Pumping Water.

WS 1. Pumping water for irrigation, by Herbert M. Wilson. 1896. 57 pp., 9 pls.
WS 8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls.
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WS 20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls.
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WS 41. The windmill; its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 p 14 pls.
WS 42. The windmill, Part II (continuation of No. 41). 1901. 73-147 pp., 15-16 pls.

(Continued on third page of cover.)

Water-Supply and Irrigation Paper No. 80 Series M, General Hydrographic Investigations, 4

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

THE RELATION OF RAINFALL TO RUN-OFF

BY

GEORGE W. RAFTER

WASHINGTON
GOVERNMENT PRINTING OFFICE
1903

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THE RELATION OF RAINFALL TO RUN-OFF.

By George W. Rafter.

INTRODUCTION.

The run-off of a stream is influenced by many complex conditions—as, for instance, amount of rainfall and its intensity, nature of soil, slope of surface, and area and configuration of catchment basin. It is also influenced by geologic structure, forests, wind, force of vapor pressure, and other elements. Data are still lacking for a really satisfactory discussion of the question, although they have accumulated so rapidly during the last few years that many conservative conclusions can be drawn which may be accepted as substantially true.

The subject has been discussed in the Transactions of the American Society of Civil Engineers by Messrs. Herschel, Fteley, FitzGerald, Babb, and others in a series of able papers,[a] but no one of these exhibits a complete view.

It has also been discussed in other publications, but so far as known to the writer the Transactions of the American Society contain the most complete discussion of the subject that can be found in English engineering literature.

As a result of many years' study of the problem indicated by the title of this paper the writer has come to the conclusion that no general formula is likely to be found expressing accurately the relation of rainfall to the run-off of streams, for streams vary widely in their behavior, and when they do agree the agreement is usually accidental. As a general proposition we may say that every stream is a law unto itself.

The final formula of run-off for a given stream, therefore, will differ in some particulars from that for every other, except that there may be accidental resemblances as regards slope, shape of catchment area, or some other peculiarity. It is, however, true that an empirical formula may be made for certain classes of streams which will give approximately the run-off for a series of years.

[a] See Trans., Vol. X, p. 225; Vol. XXVII, p. 253; and Vol. XXVIII, p. 323.

RAINFALL.

CAUSE OF RAINFALL.

The cause of rainfall has been discussed by Mr. Velschow in the Transactions of the American Society of Civil Engineers.[a] This paper may be referred to for a very good discussion of the subject.

The subject is also very ably discussed by Alfred J. Henry in one of the Weather Bureau reports.[b] Mr. Henry remarks that the theories of rainfall given in books of twenty or thirty years ago are not now wholly accepted. Still there is one simple principle upon which no disagreement exists—that in order to produce rain the temperature of the air must be suddenly cooled below the dew point. When the air is thus cooled a portion of the vapor is changed to the liquid state and the particles thus formed may float away with the wind or they may increase in size and fall to the ground by virtue of gravity. Whether the condensation results simply in cloud, or whether rain falls, depends on the magnitude of the temperature changes taking place in the air mass.

The precise manner in which air is cooled to produce rain, whether by contact or by mixing, is not clearly apprehended. Cooling by expansion, as air ascends, is one of the most effective causes of rainfall. The ascensional movement is brought about in several ways, probably the most important of which is circulation of air in cyclonic storms, by a radial inflow from all sides and an ascensional movement in the center. A very large percentage of the rain of the United States is precipitated in connection with the passage of storms of this class.[c]

Mr. Henry discusses the precipitation of the United States under the following topics: (1) The statistics used and their accuracy; (2) Geographic distribution and annual allowance; (3) Monthly distribution by districts and types; (4) The precipitation of the crop-growing season; (5) Secular variations; (6) Details of the precipitation by geographic districts; and (7) Excessive precipitation.

The chapter on "Excessive precipitation" is probably, from an engineering point of view, the most important. Mr. Henry states that in 1888 attention was first directed to the importance of statistics of excessive rainfall. At the present time the Monthly Weather Review publishes a table of maximum rainfalls in five and ten minute and one hour periods, etc.

Table No. VIII of Mr. Henry's paper gives details of excessive rainfall at Washington, Savannah, and St. Louis, and Table No. IX gives maximum intensity of rainfall for periods of five, ten, and sixty min-

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[a] The cause of rain and the structure of the atmosphere, by Franz A. Velschow: Trans. Am. Soc. Civil Eng., Vol. XXXIII, 1890, p. 303.

[b] Rainfall of the United States, by Alfred J. Henry, chief of division: Ann. Rept. Weather Bureau, 1896–97, p. 317.

[c] Abstracted from Mr. Henry's paper.

utes at the Weather Bureau stations equipped with self-registering gages, compiled from all available records. Inasmuch as this paper may be readily referred to in the publication cited, further detail is omitted.

MEASUREMENT OF RAINFALL.

The subject, "How close may rainfall be measured?" has been fully discussed by Prof. Cleveland Abbe.[a] Professor Abbe states that the influence of altitude was first brought to the attention of the learned world by Heberden who, in 1769, in a memoir in the Transactions of the Royal Society of London, stated that a gage on Westminster Abbey, over 150 feet above the ground, caught less than half as much as a gage at the ground.

Profs. Alexander D. Bache and Joseph Henry, and Mr. Desmond FitzGerald have studied the question extensively in this country. Mr. FitzGerald's results may be found in the Journal of the Association of Engineering Societies for August, 1884.[b]

Mr. FitzGerald kept two gages, one at a height of 2 feet 6 inches above the level of the ground, and the second at a distance of 150 feet from the first, and at an elevation of 20 feet 4 inches above the lower gage. Both gages were 14.85 inches in diameter. These gages were located at Chestnut Hill reservoir, in the city of Boston, but the observations for wind velocity were taken from the Signal Service observations, 5 miles distant. With only five exceptions during the five-year period, the upper gage delivered materially less water than the ground gage, the average difference being 10.6 per cent for the whole period. But snowfalls and mixtures of snow and rain are not included in the table of data given in the paper.

The results recorded by Professor Abbe are somewhat more extensive than those presented by Mr. FitzGerald, though Mr. FitzGerald states in his paper that he has prepared a series of experiments with nine gages and a self-recording anemometer, from which in the course of time some more definite results may be reached. So far as the writer knows, this second series of observations has not been published.

In order to show how the catch of rainfall diminishes with height of the gage, Professor Abbe gives in his Table No. IV the results of observations at different places. These range from 90 per cent of a gage at the ground to 47 per cent. In Tables Nos. I, II, and III, Professor Abbe also gives the result of various gages, which gave 52 to 7 per cent less of rainfall, and from 80 to 16 per cent less of snowfall, than gages at the ground. Professor Abbe remarks that these tables show conclusively the large influence of wind on the catch of rain, but show

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[a] Determination of the true amount of precipitation and its bearing on theories of forest influences, by Cleveland Abbe: Appendix I of Bulletin No. 7, Forest Influences; Forestry Division, United States Department of Agriculture.

[b] Does the wind cause the diminished amount of rain collected in elevated rain gages? By Desmond FitzGerald: Jour. Assoc. Engineering Societies, Vol. III, No. 10 (August, 1884).

nothing of its influence on the catch of snow. As an observational method of obtaining the true rainfall from gage readings, Professor Abbe suggests the following as offering a fair approximation:

If the present gage has been standing in an open field at a few feet elevation, place two or more similar gages near it, and similarly located as far as obstacles are concerned, except only that one of these is to be decidedly lower than the old one and the other decidedly higher. From a comparison of the simultaneous records of any two gages and their altitudes, we should for each separate rainfall, rather than for the monthly and annual sums, deduce the normal rainfall by the solution of two or more equations of the form:

Observe catch of gage = (1 − x altitude) × (desired catch of normal pit gage). (1)

Where x is the unknown special coefficient of deficiency due to wind at that altitude—that is to say, having two gage catches, c_1 and c_2 for the two altitudes, H_1 and H_2—we obtain the true rainfall (R) by the formulas:

$$c_1 = (1 - x\sqrt{H_1})\ R; \text{ and} \tag{2}$$

$$c_2 = (1 - x\sqrt{H_2})\ R. \tag{3}$$

whence,

$$R = \frac{c_1\sqrt{H_2} - c_2\sqrt{H_1}}{\sqrt{H_2} - \sqrt{H_1}} = c_1 + \frac{1}{\sqrt{\frac{H_2}{H_1}} - 1}(c_1 - c) = c_1 + n(c_1 - c_2). \tag{4}$$

If c_1 and H_1 relate to the lower gage, we shall generally have $c_1 > c_2$ and $H_1 < H_2$, and the coefficient n will be a positive fraction, for value of which, for such combinations as may easily occur in practice, a table is given in the paper.

It is evident then, without special discussion, that nearly all rainfall measurements thus far made in the United States are only approximations, and that while they remain in this state to carry them out to more than one decimal place is an unnecessary refinement.

DETERMINATION OF MINIMUM RAINFALL.

The writer has spent considerable time in an attempt to determine about what the minimum rainfall at any particular station may be expected to be; or, rather, he has endeavored to ascertain the relation between the minimum rainfall and the maximum. In the course of this quest he has examined practically all the records in the State of New York, as well as many records in New Jersey, Pennsylvania, Michigan, Illinois, Nebraska, Colorado, and Wyoming, as well as in Canada. As a general rule, to which there are some exceptions, the minimum rainfall may be placed at about one-half of the maximum. That is, if the maximum rainfall at a given station is about 50 inches, the minimum will be in the vicinity of 20 to 25 inches. In some cases the minimum will be not more than one-third of the maximum, or even somewhat less than one-third; occasionally, not more than one-quarter. It is not intended, however, to lay this down as an absolutely universal rule, but rather, for the present, as a somewhat imperfect guide. As a further rough guide it remains to point out that in case a given record does not conform substantially to the foregoing it may be assumed that either the minimum or the maximum,

as the case may be, is still to occur. Near the seacoast, where the supply of moisture in the air is more nearly constant, there is less variation than in the interior, and the rule that the maximum is double the minimum is more generally true. This proposition is also generally true as regards English meteorology.

IS RAINFALL INCREASING?

This question has been discussed by Prof. Mark W. Harrington,[a] who, however, reached no very definite conclusion, although he is disposed to answer it in the negative. The method of discussion followed was to reduce the annual rainfalls to a series of means of each five years. These means were entered on a succession of maps, five years apart in time, and on these maps was drawn the line of 40 inches of annual rainfall. The question to be determined is, as we draw this line for each five-year mean, Does it change its position in any regular and systematic way?

An examination of the detail shows that while these lines are subject to limited fluctuations there are no uniform or systematic fluctuations. The line of equal rainfall for 1861–1865 occupied nearly the same position as the line for 1886–1890. The variations are sometimes extensive, but without systematic progress. Professor Harrington therefore concludes that with the data at hand there is not sufficient evidence of systematic fluctuation of the rainfall.

RELATION OF RAINFALL TO ALTITUDE.

This matter has been referred to in a discussion of Mr. Noble's paper on Gagings of Cedar River, Washington,[b] where the statement has been made that in the State of New York the rainfall records show both increase and diminution of precipitation with increase of altitude. The Hudson River catchment area shows a higher precipitation at the mouth of the river than it does at its source in the Adirondack Mountains, while the Genesee River shows the opposite, namely, higher precipitation at its source than at its mouth.

According to a table of average monthly, annual, and seasonal precipitation in Mr. Turner's monograph on the climate of New York State[c] it appears that the coast region, which includes Block Island, East Hampton, Setauket, Fort Columbus, New York City, Mount Pleasant, Tarrytown, White Plains, Croton dam, and North Salem, has an average annual precipitation of 44.93 inches. With the exception of Block Island these stations are all in New York and not far

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[a] Rainfall and snow of the United States, compiled to the end of 1891, with annual, seasonal, monthly, and other charts, by Mark W. Harrington: Bulletin C, Weather Bureau, U. S. Dept. of Agriculture.

[b] Trans. Am. Soc. Civil Eng., Vol. XLI, pp. 1–26.

[c] The climate of New York State, by E. T. Turner, C. E., late meteorologist of the New York weather bureau: Fifth Ann. Rept. New York Weather Bureau, 1893. Reprinted in Eighth Ann. Rept. of the bureau, 1896.

from the coast, and they range in elevation above tide water from 16 feet at East Hampton to 361 feet at North Salem. The average elevation of the coast region is 132 feet. The records vary in length from 7 years to 49 years, with a total of 195 years. Five of the stations are in Westchester County.

As given by Mr. Turner, the northern plateau includes Constableville, Lowville, Fairfield, Johnstown, Pottersville, Elizabethtown, Keene Valley, and Dannemora, in the counties of Lewis, Herkimer, Warren, Essex, and Clinton. According to the table the average annual precipitation at these places is 38.97 inches. The elevation of the stations above tide ranges from 600 feet at Elizabethtown to 1,356 feet at Dannemora, with an average elevation of 973 feet. The records vary in length from 4 to 22 years, with a total of 73 years.

Again, the western plateau, which includes stations in Cattaraugus, Wyoming, Allegany, Steuben, Livingston, and Chemung counties, has an average elevation above tide of 1,307 feet, ranging from 1,950 feet to 525 feet, and has an average annual precipitation of 35.58 inches, while the Hudson Valley, which includes stations in Putnam, Orange, Dutchess, Ulster, Columbia, Albany, Rensselaer, and Washington counties, has an average elevation of 230 feet above tide, with an average annual precipitation of 38.46 inches. The records range from 9 years to 65 years, with a total of 277 years.

The Great Lakes region, with an average elevation of 494 feet, has an average annual precipitation of 35.17 inches, while the central lake region, with an average elevation of 690 feet, has an average annual precipitation of 43.41 inches.

Mr. Turner's table is based on a calendar year, from January to December, inclusive. Further data may be obtained from this excellent table.

In Table No. 24 of the Upper Hudson Storage Surveys Report for 1896 there is given the mean precipitation of the Upper Hudson catchment area. The stations therein included are: Albany, 1825–1895, 71 years; Glens Falls, 1879–1895, 17 years; Keene Valley, 1879–1895, 17 years; western Massachusetts, 1887–1895, 9 years; northern plateau, 1889–1895, 6½ years; Lowville Academy, 1827–1848, 22 years; Johnstown Academy, 1828–1845, 18 years; Cambridge Academy, 1827–1839, 13 years; Fairfield Academy, 1828–1849, 22 years; Granville Academy, 1835–1849, 15 years. Assuming the northern plateau as a unit the total number of years is 199½, and the mean of all is 37.4 inches. A reference to the rainfall map in the report of the United States Board of Engineers on Deep Waterways will show that this is necessarily an approximation, because of great lack of stations in the interior of this region.

As regards the catchment area of the Upper Genesee River, there is a very decided increase in rainfall as one goes toward the source. For the years 1889–1896, inclusive, the rainfall in the upper area of this stream was 42.19 inches, while at Rochester for the same years

it was 35.64 inches. This statement is especially interesting, because there seems to be a well-marked line dividing the smaller rainfalls of the lower area from the higher rainfalls of the upper. At Hemlock Lake, Avon, and Mount Morris the rainfalls are all low, the average at Hemlock Lake from 1876–1895, inclusive, being 27.56 inches. In 1880 it was 21.99 inches; in 1879, 22.16 inches, and in 1881 only 24.36 inches. We have here three years of exceedingly low rainfall, in which the run-off must have also been very low. In 1895 the rainfall at Hemlock Lake was only 18.58 inches. The average precipitation at Avon and Mount Morris from 1891 to 1896, inclusive, was 30.12 inches. In 1895 it was only 25.05 inches. The following are stations at which it was much higher for the years 1891 to 1895, inclusive: Leroy, 45.25 inches, and Arcade, 41.60 inches.

The statements of precipitation in Genesee River catchment area are all based on a water year, December to November, inclusive.

The following are from Russell's Meteorology,[a] illustrating Atlantic coast rainfalls, and are the averages derived from observations extending from 1870 to 1888. The rainfalls are stated to be fairly representative for large districts of country around the places.

At Jacksonville the weather bureau office is at an elevation above tide of 43 feet, while the average annual rainfall is 57.1 inches. At Norfolk the elevation of weather bureau is 57 feet above tide, and the average rainfall is 51.7 inches. At Boston the weather bureau office is 125 feet above tide, and the average rainfall is 46.8 inches.

The following illustrate the change as one goes north through the Mississippi Valley: At New Orleans the weather bureau office is 54 feet above tide, the average rainfall 62.6 inches; at St. Louis, weather bureau office 567 feet above tide, average rainfall 37.8 inches; at St. Paul, weather bureau office 850 feet above tide, average rainfall 28.9 inches.

The following illustrate the Rocky Mountain region: At Fort Grant, Ariz., elevation of weather bureau 4,833 feet, average rainfall 15.8 inches; at Denver, elevation of weather bureau 5,300 feet, average rainfall 14.7 inches; at Fort Benton, Mont., elevation 2,565 feet, average rainfall 13.2 inches.

The following illustrate the Pacific coast region: At Portland, elevation of weather bureau office is 157 feet, average rainfall 50.3 inches; San Francisco, elevation 153 feet, average rainfall 23 inches; San Diego, elevation 69 feet, average rainfall 10.2 inches.

These figures abundantly support the proposition that in the United States the rule of increased precipitation with higher altitude is by no means universal. The writer can not say positively, because he has not examined the vast number of records with reference to this point, but he thinks it quite possible that the reverse is more nearly true. That is, owing to distance from the ocean, prevailing direction

[a] Meteorology, by Thomas Russell, U. S. Asst. Engineer.

of wind, and other causes, it is probable that for the entire country precipitation decreases with higher altitude rather than increases.

The decision of this question will depend to some extent upon the steepness of ascent. Thus on Mount Washington, which is projected into the air far above the surrounding mountains, the rainfall is about 83 inches. In other cases, where the ascent is gradual, no increase is apparent. The same is also frequently true of sharp ascents. On Longs Peak, in Colorado (elevation 14,271 feet), the rainfall in 1899 was 16.7 inches.

Morever, the writer has mostly avoided comparatively small differences in rainfall—those not exceeding 2 to 2.5 inches. In such cases the difference is too small to be any certain guide. Especially is this true in the case of the northern plateau, where there is still a great lack of stations. The differences between high altitudes and low should be as much as 5 or 6 inches. Again, whether the excess rainfall occcurs in the winter or summer months must be taken into account. If it occurs in the summer, even 3 inches of rainfall may not make more than 0.1 or 0.2 inch in the stream. Rainfall and run-off observations are not yet, nor are they likely to ever be, definite enough to take into account an annual difference of much less than about 1 to 1.5 inches. Again, the writer has ceased to be excessively particular about the total of the annual rainfall. Assuming some considerable length of record, small errors have relatively slight effect. This matter is referred to here because nearly all rainfall records—at any rate in the United States—have more or less error in them, and while it is desirable to have records as reliable as possible, a few errors do not affect a record very seriously. It is nevertheless very desirable to know the history of the record in order to insure the degree of confidence to be placed in it.

MAP OF AVERAGE RAINFALL IN THE STATE OF NEW YORK.

On Pl. XCVIII of the Report to the United States Board of Engineers on Deep Waterways, the writer has given the average rainfall at a large number of stations throughout the State of New York. When this map was prepared considerable time was expended in drawing lines of equal rainfall upon it, but so many discrepancies appeared that it was finally concluded, for the present, that it should be allowed to stand without such lines. The only way these contours could be drawn with any satisfaction was to omit stations which conflicted too much therewith. This, the writer did not feel justified in doing. The observations are not extensive enough to enable one to draw these lines.

DIVISION OF RAINFALL AND RUN-OFF INTO STORAGE, GROWING, AND REPLENISHING PERIODS.

The writer has found it very convenient to divide rainfall and run-off records into the three periods, those of storage, growing, and

replenishing, with a water year beginning December 1 and ending November 30. The storage period includes the months from December to May, inclusive, during which the evaporation and absorption by plants are relatively slight, and a very large proportion of the rainfall appears in the streams.

The growing period, June to August, inclusive, includes the period of active vegetation, when evaporation and absorption by plants are most notable. During this period, frequently not more than 0.1 of the rainfall appears in the streams, and sometimes not more than 0.05 or even less. Ground water tends to become lower and lower during this period, unless the rainfall is much higher than the average.

In the replenishing period, September to November, inclusive, with the normal rainfall, ground water tends to recover, and the run-off is larger than in the preceding period. This period is replenishing in this, that there is a tendency to return to normal conditions.

No hard and fast rule, however, can be laid down as to the beginning and ending of these periods. In some years the beginning of the water year should be placed at November 1, instead of December 1, while in others the storage period may end with April. Very often, one period runs into another, but after considerable study the foregoing divisions have been accepted as, on the whole, best representing all the conditions. In England many hydrologists begin the water year with September 1 as best suiting the conditions. The same thing has been done by the Philadelphia water department in tabulating the data of Neshaminy, Perkiomen, Tohickon, and Wissahickon creeks and Schuylkill River.

One great advantage of dividing records into these periods is as follows: Since evaporation and plant absorption are light during the months of the storage period, it follows to a great degree that the amount of water which can be stored is exhibited by the rainfall of the storage months. Realizing this fact, it has been the writer's habit for several years, in storage projects, to first tabulate rainfall in the manner indicated. Such procedure has the advantage that it leads one away from the contemplation of mere detail. There is a positive disadvantage in considering the monthly quantities, for which there is no compensation. The division into the three periods exhibits the more important characteristics without overburdening the mind. It is believed that a considerable advance on ordinary practice has been made by proceeding in the manner stated.

LENGTH OF TIME REQUIRED TO MAKE GOOD A SERIES OF RAINFALL RECORDS.

This question is partially answered in the writer's second report on the Upper Hudson Storage Surveys, for 1896, by a short analysis

of a paper by Alexander R. Binnie, member of the Institution of Civil Engineers.[a]

One of the important problems worked out by Mr. Binnie is an answer to this question: What is the least number of years of which the continuous record, when the average rainfall has been determined, will not be materially affected, so far as the value of the mean is concerned, even if the record be extended by a greater number of years' observations? Also, What is the probable accuracy of any record the length of which is less than that necessary to give an average which will not be materially altered when the record is extended?

Space will not be taken to show Mr. Binnie's views in detail, for which reference may be made to the abstract in the second Hudson report, or, for the complete views, to the paper in the Proceedings of the Institution of Civil Engineers, but assuming that the observations are properly made it is stated that "dependence can be placed on any good record of thirty-five years' duration to give a mean rainfall correct within 2 per cent of the truth."

Further, it can be stated that for records from twenty years to thirty-five years in length, the error may be expected to vary from 3.25 per cent down to 2 per cent, and that for the shorter periods of five, ten, and fifteen years, the probable extreme deviation from the mean would be 15 per cent, 8.25 per cent, and 4.75 per cent, respectively.

A twenty years' record, therefore, may be expected to show an error of 3.24 per cent. This is about as close as rainfall records in this country can be expected to agree, as comparatively few are much beyond twenty years in length.

In his paper on the Rainfall of the United States, Mr. Henry has examined this question, using long records at New Bedford, St. Louis, Philadelphia, Cincinnati, and other places. The rainfall has been measured at New Bedford for 83 consecutive years, and at St. Louis for 60 years. For a 10-year period Mr. Henry found the following variations from the normal: At New Bedford + 16 per cent and − 11 per cent; at Cincinnati, + 20 per cent and − 17 per cent; at St. Louis, + 17 per cent and − 13 per cent; at Fort Leavenworth, + 16 per cent and − 18 per cent; and at San Francisco, + 9 per cent and − 10 per cent. For a 25-year period, it was found that the extreme variation was 10 per cent, both at St. Louis and New Bedford. Mr. Henry reached the conclusion that at least 35 to 40 years' observations are required to obtain a result that will not depart more than ± 5 per cent from the true normal. The average variation of a 35-year period was found to be ± 5 per cent, and for a 40-year period ± 3 per cent.

This preliminary study indicates slightly more range than was found

[a] On mean or average rainfall and the fluctuations to which it is subject, by Alexander R. Binnie, Inst. C. E.: Proc. Inst. C. E., Vol. CIX (1892), pp. 89-172.

by Mr. Binnie, although it may be remembered that the observations of the latter are far more extensive than Mr. Henry's.

Again, since the run-off is a function of the rainfall, it follows that it must be affected in some degree in a similar manner. As to just the relation, so far as known, very few computations have been made. Indeed, very few run-off tabulations are extant which are long enough to settle this question. It is clearly, therefore, very difficult to solve definitely so abstruse a problem as that of the extent to which forests affect rainfall. All solutions are necessarily, and will be for some time to come, tentative in their character.

RUN-OFF.

THE LAWS OF STREAM FLOW.

A general statement of these laws from Mr. Vermeule is as follows:

The waters of the earth are taken up by the process which we call evaporation and formed into clouds, to be again precipitated to earth in the form of rain or snow. Of the water which falls upon the basin of a stream, a portion is evaporated directly by the sun; another large portion is taken up by plant growth and mostly transpired in vapor; still another portion, large in winter but very small in summer, finds its way over the surface directly into the stream, forming surface or flood flows; finally, another part sinks into the ground, to replenish the great reservoir from which plants are fed and stream flows maintained during the periods of slight rainfall, for the rainfall is frequently, for months together, much less than the combined demands of evaporation, plant growth, and stream flow. These demands are inexorable, and it is the ground storage which is called upon to supply them when rain fails to do so.

All of these ways of disposing of the rain which falls upon the earth may be classed as either evaporation or stream flow. Evaporation we make to include direct evaporation from the surface of the earth, or from water surfaces, and also the water taken up by vegetation, most of which is transpired as vapor, but a portion of which is taken permanently into the organisms of the plants. Stream flow includes the water which passes directly over the sur ace to the stream, and also that which is temporarily absorbed by the earth to be slowly discharged into the streams. A portion, usually extremely small, passes downward into the earth and appears neither as evaporation nor as stream flow. It is usually too small to be considered, and we may for our purposes assume that all of the rain which falls upon a given watershed and does not go off as stream flow is evaporated, using the latter word in the broadened sense which we have above described.

Probably one very important effect of forests is that upon the ground-water flow of streams. The stream with a catchment area wholly or largely in forests will show, without exception, a much better ground flow than one with the area denuded of forests. Neshaminy and Tohickon creeks may be cited as streams with the smallest amount of forest and the lowest curve of ground-water flow. Possibly this is not entirely due to forests, but it may be assumed that they bear some relation to the result.[a]

[a] Examples of ground-water curves for the chief streams herein considered may be found in Mr. Vermeule's report on the flow of streams, etc., in Final Rept. State Geologist of New Jersey, Vol. III. Trenton, 1894.

UNITS OF MEASUREMENT.

Clemens Herschel, member American Society Civil Engineers, in his paper on Measuring Water,[a] has defined the essential elements of this question in the following terms:

For most purposes the unit of volume, when using English measures, has been agreed upon in favor of the cubic foot, and the nations of the earth being fortunately agreed upon their measures of time, have settled upon one second of time as the unit to use in measuring water. Nevertheless, the million United States gallons in twenty-four hours has become a standard for city water supply practice in the United States, and an acre in area covered an inch or a foot deep in a month or in a year is used in irrigation practice. But I would warn all engineers to be very slow to add to the number of such standards of measure for flowing water, and to abstain from and frown down such absurd standards as cubic yards per day, or tons weight of water per day, or even cubic feet per minute (instead of second), and other incongruities. * * * As exercises in the art of arithmetic for children such computations may have value, but in the work of civil engineers they become a stumbling block to an advance of knowledge, and while unduly magnifying the unessentials they indicate a deplorable lack of appreciation of the essentials of the art of the civil engineer.

Cubic measures do well enough for the contents of vessels, or as we may express it, for dealing with the science of hydrostatics. But so soon as the water to be measured is in motion, or so soon as the science of hydraulics has been entered upon, we must get clearly in our minds the idea of rates of flow, or of a procession of such cubic volumes passing a given point in a certain unit of time, as of a flow of so many cubic feet per second.

Very little can be added to what Mr. Herschel has here said. It is a clear exposition of the whole subject. Such units as cubic feet per day and cubic miles have clearly no place in a modern paper on hydrology.

The unit of inches on the catchment area may, however, be pointed out as an exception to the foregoing general rule. This unit is exceedingly convenient because it admits of expressing rainfall and run-off in the same unit and without reference to the area. It brings out a number of relations not otherwise easily shown, as will be exhibited in discussing the tables accompanying this paper.

MINIMUM FLOW OF STREAMS.

Very little can be added to our knowledge of the minimum flow of streams beyond what has already been stated in Water Supply and Irrigation Paper No. 24, Water Resources of the State of New York, Part I, which applies particularly to streams in the State of New York. Summarizing the information there given, we may say that for streams issuing from regions of heavy, compact soil, mostly deforested, the extreme minimums are likely to run as low as 0.1 of a cubic foot per square mile per second. They may even in an extreme drought go as low as 0.05 of a cubic foot per square mile per second.

[a] Measuring Water, by Clemens Herschel; An address to the students of Rensselaer Polytechnic Institute, Troy, N. Y.

Oswego River, by reason of large lake pondage, has a minimum flow of about 0.3 of a cubic foot per square mile per second. For a similar reason the Upper Hudson will not usually go less than 0.3 of a cubic foot per square mile per second, although in the summer of 1899 it probably did not exceed 0.2 of a cubic foot per square mile per second. This, however, was unusual. The streams of Long Island, issuing from sand plains, may be expected to give minimum flows of from 0.5 to 0.6 of a cubic foot per square mile per second. The streams of the northern part of New York, issuing from denser forests than the others, also give minimum yields somewhat in excess of 0.3 of a cubic foot per square mile per second. The streams tributary to Mohawk River, on the south side of the valley, will give minimum flows of not more than one-half of what the streams tributary on the north side give. As to the streams of the far West, many of them are frequently dry for several months at a time. A typical stream of this character is the Platte River, with a catchment area at Columbus, Nebr., of 56,867 square miles.[a]

CHARACTERISTICS OF THE MINIMUM RUN-OFF.

Since the rainfall varies so widely, the run-off, which is a function of the rainfall, will also vary widely. On the Hudson River the maximum run-off of 33.08 inches, with a rainfall of 53.87 inches, occurred in 1892. The minimum, with a run-off of 17.46 inches and a rainfall of 36.37 inches, occurred in 1895. On the Genesee River the observed maximum rainfall of 47.79 inches, with a run-off of 19.38 inches, occurred in 1894.[b] The minimum rainfall of 31 inches, with a minimum run-off of 6.67 inches, occurred in 1895. These figures of rainfall indicate that either the extreme maximum or the extreme minimum rainfall has not yet occurred on the catchment area of this stream.

On the Muskingum River the maximum rainfall thus far observed is 56.97 inches, with a maximum run-off of 26.84 inches, which occurred in 1890. The observed minimum rainfall of 29.84 inches, with the corresponding minimum run-off of 4.9 inches, occurred in 1895. It is also doubtful if either the extreme maximum or the extreme minimum rainfall has been yet observed on the catchment area of this stream. As to whether the rainfall will go lower there is no certain way of determining. Moreover, 4.9 inches seems a very low run-off—and the run-off is not likely to be less than this figure. However, the run-off in any year depends very largely on the rainfall of the months from

[a] For an extensive list of streams of which the maximum and minimum flows are given, the following may be consulted:

(1) Water Power of the United States, Tenth Census, Vol. I, pp. XXVIII and XXIX.

(2) Twentieth Ann. Rept. U. S. Geol. Survey, Part IV, Hydrography, pp. 46-63.

(3) Report on water supply, water power, the flow of streams and attendant phenomena, by Cornelius C. Vermeule: Final Report State Geologist of New Jersey, Vol. III.

[b] In the combined Genesee River and Oatka Creek record the maximum run-off of 21.22 inches occurred in 1890, when the rainfall is placed at 47.54 inches. This, however, is less reliable than the rainfall and run-off of 1894, which latter is accordingly given the preference.

December to May, inclusive. There may possibly be, therefore, a lower annual run-off than 4.9 inches, even though the total rainfall should exceed 29.84 inches. The rainfall for December to May, inclusive, was 13.04 inches. The run-off for that period was 4.04 inches.

DIVISION OF STREAMS INTO CLASSES.

The foregoing statements indicate that, as regards run-off, streams of the eastern part of the United States may be divided into classes. In the first class will fall streams where the maximum rainfall is from 50 to 60 inches, with corresponding run-off somewhat more than one-half of the rainfall. The minimum run-off will be about one-half the rainfall, or a little less. These statements, it may be again repeated, are general ones, to which there are exceptions.

Another class of streams, of which the Genesee and Muskingum rivers are typical, are those with maximum rainfall on their catchments of 40 to 50 inches and with corresponding run-off somewhat less than one-half the rainfall. The minimum run-off for these streams is from one-fourth to one-sixth of the corresponding rainfall, or from about 16 per cent to 25 per cent.

A further class, the far Western streams, may be mentioned, in which the run-off is only a very small percentage of the rainfall, in some cases not more than 4 per cent to 5 per cent, or at times even less. Probably comprehensive study would further subdivide these streams, but the intention at present is to merely call attention to some of the more marked peculiarities as a basis for final detailed study.

If one takes the streams of the far West, as, for instance, Loup River, in Nebraska, with a catchment area of 13,542 square miles, where the rainfall in 1894, observed at 24 stations, was, on an average, only 12.84 inches and the run-off of the stream did not much exceed 1 inch, he will find entirely different conditions from those above stated. In many cases streams in that locality run much less than 1 inch. For instance, the South Platte, at Denver, Colo., in 1896, with a rainfall of 11.84 inches, ran 0.62 inch. The catchment area at this place is 3,840 square miles. At Orchard, Colo., the South Platte, in 1898, with a rainfall of about 17 inches, ran 0.9 inch. The catchment area at this place is 12,260 square miles. The Republican River, at Junction, Nebr., with a rainfall of about 26 to 28 inches, in 1898, ran 0.39 inch. The catchment here is 25,837 square miles in extent.

The foregoing statements indicate the essential truth of the proposition already announced that, broadly, each stream is a law unto itself. Any formula, for either maximum, average, or mean run-off, which does not take this into account is incomplete.

ESTIMATION OF RUN-OFF FROM RAINFALL DIAGRAMS.

Can run-off of streams be estimated from diagrams of monthly rainfall? The writer has spent considerable time on this problem without

arriving at any very satisfactory conclusion. For some months such a diagram may be made to fit quite closely, while for others differences of as much as 2 or 3 inches appear. The conclusion of the writer is, therefore, that such diagrams are at the best crude approximations. Such study is, however, very fascinating, and it is not surprising that different hydrologists have attempted at various times its solution. Two lines of work may be mentioned. One is, by a combination of a large number of streams and their rainfall, to attempt to produce a universal formula. This, however, as has been already shown, leads to what is, in effect, a hodgepodge. Averages so applied "bring out class likenesses, to the exclusion of individual features."

The other method is to plat rainfall and run-off appearing monthly in inches, as abscissas and ordinates, respectively, and in this way to preserve the individual peculiarities of each stream. In some respects the most satisfactory way is to plat the rainfall and run-off of the storage, growing, and replenishing periods, thus grouping similar characteristics.

STORAGE IN LAKES.

The run-off of a stream is very materially influenced by the number of lakes within its catchment area. If there are many, flood flows may be expected to be very much smaller than they otherwise would be. The temporary pondage in the lakes is the cause of this. The Oswego River is a stream of this character. This stream has a total catchment area of 5,002 square miles, with something like 530 square miles of area of water surfaces—lakes, flats, and marshes. It appears, therefore, that the total area of water surfaces, flats, and marshes is about 10.6 per cent of the whole. The following lakes, ponds, and marshes are included in this catchment area: Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, Otisco, Cross, Onandaga, Cazenovia, Oneida, and Montezuma Marsh, together with a considerable number of miscellaneous small ponds and broad flat valleys.

To illustrate how these great natural reservoirs tend to prevent floods it may be mentioned that the configuration of Cayuga outlet, with relation to Clyde River, is such that frequently when there are heavy rainfalls in the catchment area of Clyde River the entire flood flow of Clyde River is discharged into Cayuga Lake, without affecting Seneca River below the mouth of Clyde River at all. It is undoubtedly due to this fact that fall floods on Oswego River are almost entirely unknown.

The evaporation of Oswego River catchment area is exceedingly large—about 28 inches—whence it results that the run-off from a mean annual rainfall of from 36 to 37 inches does not exceed about 9 or 10 inches. Owing to the large lake pondage the flood flows of this stream do not often exceed about 6 cubic feet per square mile per second.[a]

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[a] See report to the United States Board of Engineers on Deep Waterways for extended discussion on Oswego River.

COMPUTATION OF ANNUAL RUN-OFF.

No general rule can be formulated for computing annual run-off. The formulas of Mr. Vermeule are excellent formulas of the purely empirical class, applying fairly well to many streams in the northeastern part of the United States, but they do not apply at all to streams of the Middle West and Far West. Nor do they apply to some streams in the northeastern section. Nevertheless, they take into account the ground water, and are the most useful formulas thus far devised. It may be mentioned that Mr. Vermeule especially disclaims any intention of working out any formulas applying outside of the State of New Jersey. His general formula is in the nature of a suggestion.

DISCREPANCIES IN COMPUTATION OF RUN-OFF.

In computing the run-off of various streams small discrepancies will continually appear, and when such do not exceed 1 to 2 inches they are outside the limit of discussion. The question does not admit of such minuteness as to permit the discussion of small differences, although a difference of 2 inches on several thousand square miles would be much more serious than on the usual municipal catchment area of from 20 to 100 square miles. The size of the catchment area should, therefore, in this particular be taken into account.

Moreover, the run-off of streams has thus far been almost universally overestimated. Only a few are really down to the actual fact. Probably in no department of professional work are there more things to be taken into account than here.

ACTUAL GAGINGS PREFERABLE TO GENERAL STUDIES.

While on the general subject of the computation of run-off the writer may repeat what he has said in his report to the United States Board of Engineers on Deep Waterways, viz:

> The data for estimating the water supply of a large canal, especially when on a large scale, should be based, when such data are available, upon actual gagings of streams, rather than on general considerations derived from study of the rainfall alone. An examination of a large number of estimates of canal water supplies, based on the usual method, shows that rainfall data alone are in close cases inadequate for solving a water-supply problem of the magnitude of the one now under consideration. When, however, actual gagings of the streams, extending over a sufficient number of years, are available, there is no reason why a water-supply problem on a large scale may not be worked out with the precision of a proposition in mathematics.

What is here said in regard to water supples for canals is equally true as regards all other water supplies, either municipal or for water power, etc. Further on in the same chapter it is stated:

> It is not intended to say, however, that rainfall data are not of use in a hydrologic discussion. When, as in the present case, in addition to stream gagings an

extended series of such data are available, the argument is made doubly good and the demonstration strengthened.

When records of gagings are available the computation becomes very simple. It is merely a matter of simple addition and substraction.

The complete data required in order to compute the safe possible yield of a stream are as follows:

1. The catchment area.
2. The rainfall of the minimum year, as well as for a series of years.
3. A ground-water diagram of the stream or, lacking such, a diagram for a neighboring stream lying in the same or a similar geologic formation, and, so far as possible, with similar conditions of forestation.
4. The available storage capacity of the stream.
5. The loss by water surface evaporation from the reservoirs, together with an estimate of the loss by percolation.

The data required for ordinary computations may be frequently limited to the totals of the storage, growing, and replenishing periods, although when ground water is to be taken into account the monthly data should be given. The accompanying tables, Nos. 1 to 12, inclusive (pages 85–98), illustrate how such information may be placed in form for convenient use.

FORMULAS FOR RUN-OFF.

At the risk of being considered somewhat elementary the writer will give the more important of the formulas for run-off, expressed in terms of inches on the catchment area.

$$I_m = \frac{n \times Q \times 86400 \times 12}{A \times 640 \times 43560} \tag{5}$$

Whence we deduce,

$$I_m = \frac{n \times Q \times C_1}{A} \tag{6}$$

Also,

$$I_y = \frac{Q \times C_2}{A} \tag{7}$$

and

$$D = \frac{Q}{A} \tag{8}$$

To change gallons per day into inches per month we have:

$$I_m = n \times G \times C_3 \tag{9}$$

Also,

$$G = \frac{I_m}{n \times C_3}. \tag{10}$$

In the reports of the United States Geological Survey, the discharge of streams is sometimes given in acre-feet per month. To reduce such to inches per month, we have, when total acre-feet are given,

$$I_m = \frac{B \times C_4}{A}. \qquad (11)$$

In these formulas,

A=area of catchment in square miles.

B=total acre-feet per month.

D=cubic feet per second per square mile.

G=gallons per day.

I_m=inches in depth per month on the catchment area.

I_y=inches in depth per year on the catchment area.

n=number of days per month.

Q=cubic feet per second flowing from the catchment area, as determined by gagings.

$$C_1 = \text{constant} = \left(\frac{86400 \times 12}{640 \times 43560}\right).$$

$$C_2 = \text{constant} = \left(\frac{86400 \times 12 \times 365}{640 \times 43560}\right).$$

$$C_3 = \text{constant} = \left(\frac{12}{7.48 \times 640 \times 43560}\right).$$

$$C_4 = \text{constant} = \left(\frac{12}{640}\right).$$

The constants, C_1, C_2, C_3, and C_4, are left in form for logarithmic computation. For a given case, catchment area is constant, and A, in the final logarithmic form, will be combined with these.

MAXIMUM DISCHARGE FORMULA.

A considerable number of such formulas have been worked out, but the authors have taken into account so few of the controlling conditions, that they are, at the best, mostly only crude guides, and the writer long ago gave up their use, except in cases where only the roughest approximation was required. Two exceptions may, however, from the peculiar form of the coefficient, be briefly noted, viz:

$$\text{Dickens's formula, } D = C\sqrt{M^3}; \text{ and} \qquad (12)$$

$$\text{Ryves's formula, } D = C\sqrt{M^2}. \qquad (13)$$

In these formulas, D=discharge in cubic feet per second; C=a coefficient, depending for its value upon rainfall, soil, topographical slope, elevation, size of the stream, shape of the catchment, etc., and M=area of the catchment in square miles.

COEFFICIENT TABLE FOR REPRESENTATIVE AREAS.

In Mullins's Irrigation Manual[a] there are given tables for the value of the coefficients of these two formulas, together with the correspond-

[a] Irrigation Manual, by Lieut. Gen. J. Mullins (published for Madras Government), 1890.

ing depth in inches, drained off from the given areas, and the discharges in cubic feet per second. These two formulas are cited because they take into account the principle of the sliding coefficient, as does the Kutter formula, a principle which, all things considered, is the most useful thus far devised. It is true that maximum discharge formulas have been devised taking into account average slope, depth, and intensity of rainfall, area of the mountainous part of the watershed and area of flat part of the same in square miles, and length of stream from source to point of discharge. These formulas, however, also involve from one to two coefficients and become complicated in use without, it is believed, any special gain over the simpler expressions cited. The formulas of Dickens and Ryves, which comprise within the coefficient C everything included in the more complicated formulas, were the forerunners of all formulas of this class.

COOLEY'S FORMULAS.

In an able paper[a] Mr. George W. Cooley, C. E., gives the following formulas for run-off:

For a watershed without lakes,

$$F=0.844\ LRC. \tag{14}$$

For a watershed with large lakes as receiving reservoirs,

$$F=(R+\frac{LRC}{W}-E)\times 0.844\ W. \tag{15}$$

In which, F=flow in cubic feet per second.
R=precipitation in feet.
L=land surface of watershed in square miles.
W=Water surface of reservoirs in square miles.
E=Evaporation in feet.
C=Coefficient of available rainfall.

The constant 0.844 is equal to the number of feet in a square mile divided by the seconds in a year.

In these formulas the sliding coefficient is also recognized. The results, however, are based on averages, although it seems clear enough that in either power or water supply works what is wanted is the minimum run-off for a year or a series of years. For instance, the minimum rainfall at Lake Minnetonka in 1889 was only 18.36 inches, while the maximum in 1892 was 37.90 inches, or a little more than double the minimum. It is evident enough to any person who has gaged streams extensively that the run-off in 1889 must have been very much less than in 1892. In the absence of statements as to the amount of run-off in 1889, the writer can only estimate it, but

[a] Hydrology of the Lake Minnetonka watershed, by George W. Cooley, C. E.: Monthly Weather Review, January, 1899.

he doubts if it were over 10 per cent to 12 per cent of the rainfall. Probably about 2 inches is not far from the mark. What is wanted, therefore, is a concise statement, not only in this case but in every other, of the run-off of the year or series of years of minimum rainfall.

DANGER OF USING AVERAGES.

The writer has dwelt upon the foregoing point somewhat because only a very few of the more advanced students of hydrology have thus far fully appreciated its importance. A very large proportion of all the papers and reports prepared in the last ten years have proceeded on the supposition that safe deductions could be made from an average run-off. It is needless to say that all such are, without exception, erroneous. What is wanted is a clear statement of the minimum, together with the longest period which such minimum may be expected to occupy. A study of the meteorological records of the State of New York shows that the minimum period may be expected frequently to extend over three years. In the writer's report to the United States Board of Engineers on Deep Waterways, in the chapter on the meteorology of New York and the relation of precipitation to run-off, a large number of specific cases are cited, but space will not be taken here to discuss them. This proposition is true for other regions than the State of New York.

DANGER OF USING PERCENTAGES.

A much greater danger arises from the use of percentage of rainfall appearing in run-off. In many reports and papers it is assumed that averages of a series of percentages can be safely taken. The following illustration, with five cases drawn from observation, may be taken to show that this is erroneous:

Run-off, per cent of rainfall.

Case.	Rainfall.	Run-off.	Per cent.
	Inches.	*Inches.*	
1	44.3	20.1	45.37
2	62.5	35	56
3	16.2	1.2	7.41
4	24.3	2.5	10.29
5	40.4	13.1	32.42
	187.7	71.9	5)151.49
			30.29
		$\frac{\text{Run-off}}{\text{Rainfall}} = \frac{71.9}{187.7}$	=38.31
		Difference	= 8.02

As a corollary to the preceding proposition, it follows that the ratio between annual rainfall and run-off known as the "run-off coefficient or factor" is essentially misleading. A realization of this fact has led the writer, in his report to the United States Board of Engineers on Deep Waterways, to practically expurgate this statement, or anything approximating to it, from his report. The expressions "average run-off" and "percentage of the rainfall" do not appear.

Attention may also be again directed to the fact that the total run-off of a stream in any given year depends very largely on the run-off of what may be termed the "storage period." Usually about 0.75 to 0.85 of the total rainfall of this period appears as run-off in the stream, while for the summer, or growing period, not more than about 0.1 of the rainfall appears. This great difference is due to greater evaporation, as well as to the absorption of water by plants during this period. The total amount for the year which will appear as run-off in the stream will depend, therefore, very largely on whether or not the rainfall of the storage period—December to May, inclusive—is large or small. If the winter rainfall is relatively large, the run-off will also be relatively large, even though the total rainfall for the year is small. This fact must be taken into account in estimating the value of streams. Whether any given stream is low during the summer months or has then a well-sustained flow will depend very largely on the rainfall of the month of May. When the May rainfall is heavy enough to produce full ground water, the flow is likely to be well sustained, even though the rainfall is comparatively low during the summer months following. If, on the contrary, the May rainfall is so low as to leave a deficiency in ground water for that month, the flow will be low during the summer, even though the rainfall is large.

The foregoing also explains why for certain years the run-off of a stream may be relatively small, even with rainfall considerably above the average.

To more particularly illustrate this, assume a stream with, say, 6 inches of ground-water flow and further assume that on any convenient date the ground water is practically depleted. Under these circumstances, the 6 inches of ground water must fill up before any very large flow can occur. On the other hand, we may consider the sequence of the rainfall such as to leave full ground water, whence it results that there will be a much larger run-off, even though rainfall and other conditions are the same.

What is wanted in a stream, therefore, is as large a ground flow as possible, with small evaporation. That there are very great differences in streams in this respect may be easily seen by examining a series of tables of stream flow. It may be remarked that these two conditions are obtained only on a forested area, for proof of which see Bulletin No. 7, Department of Agriculture, Forest Influences.

EFFECT OF LOW GROUND WATER.

Moreover, when rainfall is below the mean for several months, the ground water may be expected to become continuously lower. This is a subject about which comparatively little is known, although the data are very important in estimating the permanency of a stream. Aside from Mr. Vermeule's, the most satisfactory discussion which the writer has seen is that of Mr. W. S. Auchincloss.[a] This paper, while too long to be abstracted, is nevertheless very interesting, because the author recognizes the limitations of averages. On page 10, after giving a table of the average rise of his sublake, he states:

> Since the table was built up from averages, we must not expect it to emphasize special variations, for the grouping of averages resembles the grouping of pictures in composite photography. The combination invariably brings out class likenesses to the exclusion of individual features. Thus the table loses sight of an extraordinary year like 1889—full of plus quantities—also seasons of drought, like 1894 and 1895. It, however, clearly shows that influx has a tendency to prevail between February and July, inclusive, and efflux to hold the mastery during the remaining months of the year.

Though this paper does not fully recognize the wide variation occurring at different localities, this is probably not due to oversight, but merely to the fact that the author was discussing a specific case. The observations recorded were made at Bryn Mawr, Pa. The paper is valuable and well worth the attention of students of hydrology.

VERMEULE'S FORMULAS.

These formulas are somewhat different from those previously considered. Mr. Vermeule claims to have discovered a relation between evaporation and mean annual temperature. For the relation between annual evaporation and annual precipitation on Sudbury, Croton, and Passaic rivers he gives the following:

$$E=15.50+0.16\ R, \tag{16}$$

In which E=the annual evaporation and R=the annual rainfall.

In the original publication of his formula, in the Report of the Geological Survey of New Jersey,[b] Mr. Vermeule allowed for other catchment areas an increase or decrease of 5 per cent from values given for evaporation on the Sudbury, Croton, and Passaic rivers. The following is his general formula for all streams:

$$E=(15.50+0.16\ R)\ (0.05\ T-1.48) \tag{17}$$

This, however, he states is merely a suggestion. His purpose is to deduce laws which hold for the State of New Jersey alone.

In these formulas the evaporation is taken to include all the various losses of water to which a catchment area is subject, including direct evaporation as well as water absorbed and transpired by plant growth, etc. Hence,

$$F\ (\text{run-off})=R-E. \tag{18}$$

[a] On Waters within the Earth and Laws of Rainflow, by W. S. Auchincloss, C. E. Philadelphia, 1897.

[b] Report on water supply, water power, the flow of streams, and attendant phenomena, by C. C. Vermeule: Final Report State Geologist of New Jersey, Vol. III. Trenton, 1894.

Mr. Vermeule gives the following formulas for the Sudbury, Croton, and Passaic rivers:

$$\text{December–May, } E=4.20+0.12\ R; \tag{19}$$

$$\text{June–November, } E=11.30+0.20\ R. \tag{20}$$

These formulas take into account the fact that evaporation is low in the winter months and high during the summer.

Mr. Vermeule also gives the following formula for computing monthly evaporation from the monthly rainfall for Sudbury, Croton, and Passaic catchment areas:

[e=monthly evaporation; r=monthly rainfall.]

December	$e=0.42+0.10\ r$	
January	$e=0.27+0.10\ r$	
February	$e=0.30+0.10\ r$	
March	$e=0.48+0.10\ r$	
April	$e=0.87+0.10\ r$	
May	$e=1.87+0.20\ r$	
June	$e=2.50+0.25\ r$	
July	$e=3.00+0.30\ r$	(21)
August	$e=2.62+0.25\ r$	
September	$e=1.63+0.20\ r$	
October	$e=0.88+0.12\ r$	
November	$e=0.66+0.10\ r$	
Year	$e=15.50+0.16\ r$	

To obtain the monthly evaporation for other streams the results obtained are multiplied by the following:

$$(0.05\ T-1.48.)$$

In which T=mean annual temperature.

At this point Mr. Vermeule was confronted by the difficulty of ground storage. In regard to the effect of this it may be mentioned that, with rainfall above the average continuously for several years, ground water may be expected to stand above its average height, yielding to streams the maximum flow possible to ground water. On the other hand, when the rainfall is below the average for a number of years ground-water flow will be lower, becoming less and less as the rainfall approaches the minimum. It is very important that this fact be taken into account, because without it one is certain to fall into error. The formulas for average depletion may be given as follows:

$$d_2=d_1+e+f-r; \tag{22}$$

$$d=\frac{f}{2}+d_1-\frac{r-e}{2}. \tag{23}$$

In which d_1 and d_2=depletion at end of previous month and for the month under consideration; d=average depletion; e and r=monthly evaporation and monthly rainfall, respectively, and f=computed monthly flow.

The foregoing does not fully express the use of these formulas, but as all that is wanted at this time is an illustration of methods, this brief account may be deemed sufficient.

Mr. Vermeule gives a diagram showing ground flow for the several different streams mentioned for a given depletion, which is to be used in conjunction with the foregoing formulas. In his opinion the diagrams present advantages over a ground-flow formula with varying constants and coefficients for different streams, being more readily compared and insuring greater accuracy. Later, in his report on forests,[a] Mr. Vermeule modifies his formula, as follows:

$$E=(11+0.29\ R)\ M. \qquad (24)$$

In which E=evaporation, R=rainfall, and M is a factor depending upon the mean temperature of the atmosphere. The writer understands Mr. Vermeule to say that this is also an expression for annual evaporation.

Values of M for given mean annual temperatures are as follows:

40°, 0.77; 41°, 0.79; 42°, 0.82; 43°, 0.85; 44°, 0.88; 45°, 0.91; 46°, 0.94; 47°, 0.97; 48°, 1; 49°, 1.03; 50°, 1.07; 51°, 1.10; 52°, 1.14; 53°, 1.18; 54°, 1.22; 55°, 1.26; 56°, 1.30; 57°, 1.34; 58°, 1.39; 59°, 1.43; 60°, 1.47; 61°, 1.51.

In a table on page 149 of the Report on Forests Mr. Vermeule compares observed annual evaporation with computed annual evaporation. The following are some of the differences which appear:

On the Genesee River the observed annual evaporation is 27.2 inches; computed annual evaporation, 20.6 inches; the observed annual evaporation, therefore, is 6.6 inches, or 32 per cent, greater than the estimated annual evaporation. On the Musconetcong River the observed, as compared with the computed evaporation, is 13 per cent less; on the Pequest it is 17 per cent less; on the Paulinskill it is 14 per cent less; on the Tohickon, 32 per cent less; on the Neshaminy, 16 per cent less; on the Perkiomen, 17 per cent less; on the Desplaines, 21 per cent greater; on the Kansas, 15 per cent greater; on the Upper Hudson, 10 per cent greater; on Hemlock Lake, 18 per cent less; on the Potomac, 17 per cent less; on the Savannah, 13 per cent less. For the rest of the streams cited in the table the agreement is closer than this.

The observed annual evaporation is 32 per cent greater than the computed annual evaporation on the Genesee River and 32 per cent less on Tohickon Creek—a range of 64 per cent. Somewhat similar differences are found on other streams where the gagings are approximately right. As to the gagings referred to in the report on forests, the writer will show farther on in this paper that gagings of Genesee and Hudson rivers are, on the whole, probably the best thus far made in the United States. Tohickon, Neshaminy, and Perkiomen creeks have been gaged by Francis weirs, and are, with the exception of Tohickon, considered approximately right. The difficulty here is probably in the flood flows. The writer understands

[a] Report on forests, by C. C. Vermeule: Ann. Rept. State Geologist New Jersey for year 1899. Trenton, 1900.

that Mr. Vermeule used the Francis formula for a sharp-crested weir. The gagings of Sudbury, Cochituate, and Mystic rivers have been deduced, it is believed, by Mr. Francis's formula for the Merrimac dam. As to Desplaines River, a discharge curve determined by current meter has, it is believed, been applied.[a] The English streams cited, Lea, Wandle, Thames, etc., have probably been gaged by a sharp-crested weir, and the others mostly by the current meter and a rating table.

RUSSELL'S FORMULAS.

Mr. Thomas Russell[b] gives the following formulas for the run-off of the Ohio, Upper Mississippi, and Upper and Middle Missouri valleys, in terms of the annual rainfall. For the Ohio River the formula is as follows:

$$O=0.600+0.95\ R-0.90\ R\ (0.975\ e-0.421\ e^2+0.626\ e^3). \qquad (25)$$

For the Upper Mississippi it is:

$$O=0.50+0.93\ R-0.88\ R\ (1.131\ e-0.383\ e^2). \qquad (26)$$

For the Upper and Middle Missouri it is:

$$O=0.12+0.98\ R-0.93\ R\ (0.91\ e-0.220\ e^2+0.009\ e^3). \qquad (27)$$

In these formulas R is the rainfall for the month in cubic miles; e is the quantity of water required to saturate the air at any time, equal to the difference between what the air contains and the amount if it was saturated; and O is the outflow or run-off.

These formulas are interesting in the present connection, because they recognize the fact that every stream must have its own formula. The variation in run-off on the Ohio, Mississippi, and Missouri rivers will be observed on inspection of the formulas. Like all formulas of this class they are subject to considerable variation. In the month of October, 1881, the computed outflow of Missouri River was 4.9 cubic miles and the observed flow was 1.6 cubic miles, a difference of 3.3 cubic miles.

RELATION BETWEEN CATCHMENT AREA AND MAXIMUM, MINIMUM, AND MEAN RUN-OFF.

It is quite common for hydrologists to assume that there is a relation between catchment area and maximum, minimum, and mean run-off, the general proposition being that mean annual run-off varies inversely as the size of the catchment, and that maximum run-off, or flood flow, varies directly as the size of the catchment.

In order to gain some idea as to the applicability of this proposition, the résumé of discharge data, in the Twentieth Annual Report of the

[a] Data pertaining to rainfall and stream flow, by Thomas T. Johnston: Jour. Western Soc. Engrs., Vol. I, No. 3, June, 1896.

[b] Rainfall and river outflow in the Mississippi Valley, by Thomas Russell: Ann. Rept. Chief Signal Officer for the year 1889, Part I, Appendix 14.

United States Geological Survey, pages 46–64, has been examined. This table includes about 225 streams in various portions of the United States, with records ranging from 18 to 20 years in length to 1 year. A few of the best-known streams—as, for instance, the Croton and Sudbury—are not given in detail, although the large number included in this table, it is believed, is sufficient to settle definitely this question. Only a very few of the results will be referred to here.

In the first place, it appears certain that with equal rainfall there is no very definite relation between size of catchment area and mean annual run-off. For instance, the Kennebec, at Waterville, Me., with a catchment area of 4,410 square miles, has a mean annual run-off for 6 years of 22.4 inches. The Cobbosseecontee, at Gardiner, Me., with a catchment area of 230 square miles, has a mean annual run-off for 6 years of 18.5 inches. The Androscoggin, at Rumford Falls, Me., with a catchment area of 2,220 square miles, has for 6 years a mean annual run-off of 24.2 inches. The Presumpscot, at Sebago Lake, Me, with a catchment of 470 square miles, has a mean annual run-off for 11 years of 21 inches. The Merrimac, at Lawrence, Mass., with a catchment area of 4,553 square miles, has a mean annual run-off for 9 years of 21.3 inches. Aside from the Androscoggin River these five streams support the proposition that the run-off varies in some degree directly as the drainage area instead of inversely.

As to the maximum run-off, or flood flow, there is apparently some slight relation, although even this is less definite than has usually been assumed.

As to minimum run-off, there is apparently no relation, extremely small flows happening on large streams as well as on the smallest. There is, however, much more definitely a relation between the run-off and the rainfall, run-off increasing as rainfall increases, and conversely.

As regards the division of streams into classes in proportion to size of catchment area, it appears, therefore, that aside from maximum run-off one is not, on present information, justified in such classification, and even in cases of flood flow it is quite probable that there are other considerations of such importance as to render a classification of this character inexpedient.

In the rivers for which data are given in this paper the catchment areas vary from 18.9 square miles for Lake Cochituate to 10,234 square miles for the Connecticut River. Since there is no very definite relation between size of catchment and run-off there is no reason why the comparison may not be made of streams having such large difference in size of catchment. For some streams—as, for instance, Pequannock River—where the slopes are very steep, the run-off is somewhat higher than it would be with other conditions the same, but with flatter slopes. But generally the degree of forestation and other elements exercise so much more important an influence that a comparison, without regard to size of catchment area, may be legitimately

made. Nevertheless, this proposition is possibly debatable, and for the present the conclusions drawn are tentative merely.

THE EXTREME LOW-WATER PERIOD.

In the discussion of Tables Nos. 1–12, inclusive, the writer has given the low water of the minimum year, but this does not usually include the extreme low-water period, which is in almost every case much more than one year. Space will not be taken to show the extreme low-water periods of all these tables. It is considered that illustrations from Muskingum and Genesee rivers are sufficient. This information is given in Tables Nos. 14 and 15.

On the Muskingum River three low-water periods have occurred during the time covered by the gagings. The first was from December, 1887, to November, 1889, inclusive, a period of twenty-four months, during which the total run-off was 18.55 inches, or if we assume a reservoir on said stream of 20 square miles water surface, the total net run-off becomes 18.15 inches. The computations of evaporation, etc., for such a reservoir, neglecting variation in water surface, are as follows. Assume an annual evaporation of 40 inches and with distribution for the several months as per column 1 in the following table. Since the water surface area is 20 square miles, it becomes 20/5828 of the whole, or 1/292. Hence, water surface evaporation is 1/292 of 40 inches, and making the computation for each month, we have the quantities as per column 2:

Total evaporation and evaporation per square mile of water surface in Muskingum Basin.

Month.	1. Total evaporation.	2. Evaporation per square mile of water surface.
January	1.00	0.0034
February	1.10	.0037
March	1.70	.0058
April	3.00	.01029
May	4.60	.01578
June	5.65	.01938
July	6.10	.02092
August	5.60	.01921
September	4.15	.01423
October	3.35	.01149
November	2.25	.00772
December	1.50	.00514
	40.00	.....

With some allowance for percolation, leakage, etc., the total is taken at 0.40 of an inch per year. Analyzing the first period, we find that for 24 months there was an average flow of 0.76 inch per month, for 12 months an average flow of 0.67 inch, and for 9 months an average flow of 0.43 inch.

The second low-water period was from May, 1891, to January, 1893, inclusive, a period of 21 months, during which time the net run-off was 17.2 inches, yielding for the whole 21 months an average of 0.82 inch and for 7 months an average of 0.36 inch.

The most extreme low-water period was from April, 1894, to November, 1895, inclusive, a period of 20 months, during which time the net run-off did not exceed under the assumed conditions 7.09 inches. The average run-off for 20 months was 0.354 inch and for 7 months 0.116 inch.

On Genesee River there have been two low-water periods during the time covered by the gagings. The first was from June, 1894, to February, 1896, a period of 21 months, during which time there was a gross run-off of 13.02 inches. Evaporation has been computed for a proposed reservoir of 12.4 square miles water-surface area, with allowance for actual height of water during the different months. On this basis and with a small allowance for percolation, leakage, etc., the total evaporation loss for the 21 months becomes 0.65 inch, leaving a net run-off of 12.37 inches. The average run-off for 21 months was 0.59 inch, or, if we assume 1.43 inches left in reservoir at end of period, the average allowable run-off becomes 0.52 inch. For 10 months, with some allowance, the average run-off is 0.30 inch and for 7 months 0.10 inch.

The second period was from June, 1896, to December, 1897, a period of 19 months, during which time the net run-off was 13.24 inches. The average run-off for 19 months, with 1.24 inches left in reservoir at end of the period, was 0.63 inch; for 8 months, 0.31 inch, and for 6 months, 0.17 inch. These figures, without being exhaustive, show that Genesee River is a somewhat better water yielder than Muskingum River.

A large number of other interesting and valuable tabulations could be drawn from these data, especially those relating to storage. But since this element is not specially considered in this paper they are not given. In any case, enough has been said to sustain the statement that streams vary, not only as regards their total capability of yielding water, but as regards its distribution. In order to develop a stream to its maximum capacity for either water power or municipal purposes it is absolutely indispensable to have a series of carefully prepared gagings. Lacking these, there should be gathered as long a rainfall record as possible, from which, by comparison, the approximate run-off of the stream may be computed. A carefully taken series of gagings is, however, in every way preferable.

VARIATION IN WEIR MEASUREMENTS.

The writer has shown[a] the considerable variation in weir measurements due to difference in form of weir alone. So great are these that any conclusions based upon the data of sharp-crested weirs applied to other forms are extremely unsatisfactory. In one case of a flat-crested weir, the flow at a given depth is only 75 per cent of what it is over a sharp-crested weir. Variations of from 5 per cent to 20 per cent are common, as may be easily observed by examining the tables in the paper cited.

In view of the importance which gagings are now shown to bear in estimating the value of a stream for water power or city water supply, in future every statement of stream flow should be accompanied by a concise statement of the method of gaging used, thus permitting hydrologists to judge of the general reliability of the method. Had this been done in the past, some of the uncertainty which now attaches to many gaging records would undoubtedly be removed.

GENESEE AND HUDSON GAGINGS REDUCED TO SHARP-CRESTED WEIR MEASUREMENTS.

The writer has shown in another place that Genesee River gagings which were made by him have been reduced to sharp-crested weir measurements. As to the Hudson gagings, Pl. CXXVII in the Report to the United States Board of Engineers on Deep Waterways may be cited. This plate is a comparison of the discharge over weirs by different formulas, and it appears from it that Mullins's formula for a flat-crested weir, which has been used for the Upper Hudson gagings, at a depth of 4 feet gives results less than Francis's formula for a sharp-crested weir by about 10 per cent. However, in order to simplify the computation and to avoid velocity of approach, the width of the crest was taken at 5 feet. Again, the crest at Mechanicville is not flat, but is slightly sloping backward. The sloping front probably affects the flow to increase it somewhat. There are also flashboards used during low water, which are properly computed by Francis's formula for a sharp-crested weir. These several elements undoubtedly make the problem somewhat complicated, but taking everything into account it is probable that the results as computed are not far from right. They may, however, be in error as much as 2 inches per year.[b]

As regards the relation between mean annual temperature and evaporation, the questions raised by Mr. Vermeule are very interesting and have received considerable study from the writer ever since the publication of Mr. Vermeule's report in 1894. This study has been specially directed toward determining whether there was any

[a] On the flow of water over dams: Trans. Am. Soc. C. E., Vol. XLIV, p. 220.
[b] See the diagrams of Hudson and Genesee rivers on this point.

way of showing by diagrams, definitely, that any such relation really existed. A concise résumé of such study will now be given.

EVAPORATION.

FITZGERALD'S FORMULA FOR EVAPORATION.

In the first place we may consider Mr. FitzGerald's formula for evaporation,[a] which is:

$$E=\frac{(V-v)\left(1+\frac{W}{2}\right)}{60}. \tag{28}$$

In this formula V=the maximum force of vapor in inches of mercury corresponding to the temperature of the water; v=the force of vapor present in the air; W=the velocity of the wind in miles per hour; and E=the evaporation in inches of depth per hour. It can be shown that there is going on nearly always a condensation of moisture from the air upon any water surface. At the same time there is going on a loss of moisture from the water surface by evaporation. The intensity of both these operations depends upon the difference in temperature between the air and any water surface with which it may be in contact. When the temperature of air and water is the same, both processes stop. Evaporation is, therefore, in effect the measure of the difference of these two exchanges. The velocity of the wind is also seen to exert a very decided effect on the intensity of evaporation.

In the foregoing formula, v, the force of vapor present in the air is computed by the following:

$$v=V-\frac{0.480\,(t-t')}{689-t'}h, \tag{29}$$

In which v=the force of vapor in the air at the time of the observation;

t=the temperature of the air in centigrade degrees, indicated by the dry thermometer;

t'=the temperature of evaporation given by the wet thermometer;

V=the force of vapor in a saturated air at the temperature t'; and

h=the height of the barometer.

There is no difference between evaporation from a water surface and evaporation from land, except that on a water surface it goes on continuously, while on land evaporation may be interrupted from lack of something to evaporate. The preceding formula shows that the force of vapor is dependent upon the difference of the dry and wet bulb thermometers, and not in any degree upon the mean annual temperature.

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[a] Trans. Am. Soc. C. E., Vol. XV, pp. 581-646.

EVAPORATION RELATIONS.

Prof. Cleveland Abbe[a] gives the following relations of evaporation, as established by Prof. Thomas Tate:

(*a*) Other things being the same, the rate of evaporation is nearly proportional to the difference of the temperatures indicated by the wet-bulb and dry-bulb thermometers.

(*b*) Other things being the same, the augmentation of evaporation due to air in motion is nearly proportional to the velocity of the wind.

(*c*) Other things being the same, the evaporation is nearly inversely proportional to the pressure of the atmosphere.

(*d*) The rate of evaporation of moisture from damp, porous substances of the same material is proportional to the extent of the surface presented to the air, without regard to the relative thickness of the substances.

(*e*) The rate of evaporation from different substances mainly depends upon the roughness of, or inequalities on, their surfaces, the evaporation going on most rapidly from the roughest or most uneven surfaces; in fact, the best radiators are the best vaporizers of moisture.

(*f*) The evaporation from equal surfaces composed of the same material is the same, or very nearly the same, in a quiescent atmosphere, whatever may be the inclination of the surfaces; thus a horizontal plate with its damp face upward evaporates as much as one with its damp face downward.

(*g*) The rate of evaporation from a damp surface (namely, a horizontal surface facing upward) is very much affected by the elevation at which the surface is placed above the ground.

(*h*) The rate of evaporation is affected by the radiation of surrounding bodies.

(*i*) The diffusion of vapor from a damp surface through a variable column of air varies (approximately) in the inverse ratio of the depth of the column, the temperature being constant.

(*j*) The amount of vapor diffused varies directly as the tension of the vapor at a given temperature, and inversely as the depth of the column of air through which the vapor has to pass.

(*k*) The time in which a given volume of dry air becomes saturated with vapor, or saturated within a given percentage, is nearly independent of the temperature if the source of vapor is constant.

(*l*) The times in which different volumes of dry air become saturated with watery vapor, or saturated within a given per cent. are nearly proportional to the volumes.

(*m*) The vapor already formed diffuses itself in the atmosphere much more rapidly than it is formed from the surface of the water. (This assumes, of course, that there are no convection currents of air to affect the evaporation or the diffusion.)

EFFECT OF WIND AND OTHER METEOROLOGICAL ELEMENTS.

That the velocity of the wind must have a very material effect upon evaporation, and hence upon the run-off of streams, is at once apparent on inspection of Mr. FitzGerald's evaporation formula, given in a preceding chapter. Again, on examining the annual summaries in the report of the Chief of the Weather Bureau the average yearly velocity of wind is found to vary from about 3 miles to 16 or 18 miles.

[a] Preparatory studies for deductive methods in storm and weather predictions, by Prof. Cleveland Abbe: Ann. Rept. Chief Signal Officer for 1889, Part I, Appendix 15.

With other conditions the same, evaporation will be much larger with a higher wind velocity.

The preceding summary of evaporation relations further shows that evaporation will vary in some degrees in proportion to pressure, temperature, moisture—which may be taken to include dew-point, relative humidity, vapor pressure, precipitation, and cloudiness—and, finally, in proportion to average velocity of the wind. It may also be expected to vary in some degree in proportion to electrical phenomena—thunderstorms, auroras, etc.—but as yet we know so little about these that they can be no more than mentioned. The writer, however, believes that studies in the direction here indicated would be very prolific of results. For this purpose two or three stations, observing all the elements herein enumerated, should be established in each catchment area.

In the present study an attempt has been made to correlate these elements with the run-off, but, aside from the rainfall, the data are too indefinite for satisfactory results. It is for these reasons, with others, that the writer is able to give only tentative conclusions in regard to the relation of rainfall to the run-off of streams.

PERSISTENCY OF RATE OF EVAPORATION.

The persistency of the amount of evaporation for any given stream at about the same figure through long periods of time was first pointed out by Messrs. Lawes, Gilbert, and Warrington in their classical paper, On the Amount and Composition of Rain and Drainage Waters Collected at Rothampsted, published in the Journal of the Royal Agricultural Society of England for 1881. As to why evaporation exhibits such persistency these distinguished authors consider it largely due to the fact that the two principal conditions which determine large evaporation—namely, excessive heat and abundant rain—very rarely occur together. The result is, especially in the English climate, a balance of conditions unfavorable to large evaporation. In a wet season, when the soil is kept well supplied with water, there is at the same time an atmosphere more or less saturated, with an absence of sunshine; while in dry seasons the scarcity of rain results in great dryness of the soil, with scant, slow evaporation.[a]

NEGATIVE EVAPORATION.

In a strictly scientific sense this term is taken to mean that when the temperature of the evaporating surface is lower than the dew-point, water is deposited on that surface. As regards the rainfall, run-off, and evaporation tables, herewith included, negative evaporation means that the run-off for certain months is greater than the rainfall. Sometimes this may legitimately happen when a heavy rain-

[a] Since the persistency of evaporation has been extensively discussed in the writer's paper on Stream flow in relation to forests (see footnote on p. 54), it is merely touched on here.

fall comes at the end of the month, or when, with much snowfall, the temperature of the month is mostly below freezing. In order to show as much as possible in regard thereto, the writer gives the detail for each of the 12 tables, together with a tentative view as to the real significance of the so-called negative evaporation.

On Muskingum River, during the 8 years gaged, negative evaporation is shown only twice for one month.

On Genesee River the detailed tabulation shows negative evaporation 5 times for one month and once for two consecutive months, a total of 7 months in all.

On Croton River, for the entire period of 32 years, negative evaporation is shown 29 times for one month and 6 times for two consecutive months, a total of 41 months in all.

On Lake Cochituate negative evaporation is shown 24 times for one month, 3 times for two consecutive months, and twice for three consecutive months, a total of 36 months in all. Negative evaporation is also shown once for the entire storage period in 1891.

On Sudbury River it is shown 16 times for one month, 9 times for two consecutive months, and 3 times for three consecutive months, a total of 43 months in all.

On Mystic Lake it is shown 12 times for one month, twice for two consecutive months, once for three consecutive months, and once for four consecutive months, a total of 23 months in all.

On Neshaminy Creek negative evaporation is shown 6 times for one month, 5 times for two consecutive months, and once for three consecutive months, a total of 19 months in all.

On Perkiomen Creek negative evaporation is shown 10 times for one month, twice for two consecutive months, and twice for three consecutive months, a total of 20 months.

On Tohickon Creek it is shown 11 times for one month, 4 times for two consecutive months, twice for three consecutive months, and once for four consecutive months, a total of 29 months. The year 1884 shows a negative evaporation of 1.21 inches for the entire storage period, and the year 1899 a negative evaporation of 2.37 inches for the entire storage period. This latter is so large that it has seemed best to reject the year 1899. Probably the year 1884 should also have been rejected, but it has been allowed to remain.

On Hudson River negative evaporation is shown 7 times for one month and 4 times for two consecutive months, a total of 15 months.

On Pequannock River it is shown 9 times for one month and 5 times for two consecutive months, a total of 19 months.

On Connecticut River negative evaporation is shown 6 times for one month, 9 times for two consecutive months, and once for three consecutive months, a total of 27 months. The year 1873 shows −3.64 inches in the storage period, and for the year 1874 the positive evaporation of the storage period is only 0.04 inch; for 1876 it is for

the same period —2.24 inches. The years 1873, 1874, and 1876 have been rejected in computing the means.

The writer has no doubt that, except in cold climates, when negative evaporation occurs for three or more consecutive months, there is an error in the gagings. He also doubts their accuracy somewhat when negative evaporation appears for two consecutive months. As regards the storage period, there is no difficulty in accepting it for one month as true, because rainfall or snowfall at the end of the month can be easily carried over to the next. This is also true sometimes for two months, but for the present it seems quite doubtful that other than in exceedingly rare cases would negative evaporation occur for three consecutive months. Its occurrence for six consecutive months, or for the entire storage period, is believed to be impossible. It may, however, be again pointed out that its occurrence renders an attempt at monthly diagrams showing the relation between rainfall and run-off absurd.

Assuming that the foregoing propositions are reasonably true, it follows that the frequency of the occurrence of negative evaporation in gaging records may be in some degree a criterion as to their accuracy. The writer, however, does not wish to urge this very strongly, but merely to point it out as a possibility.

In reference to Tables Nos. 1–12, inclusive, it may be stated that these are really all that are available for such a discussion. There are several stream-flow records which are nearly as accurate as any herein included, but unfortunately they were not accompanied by records of rainfall, and the considerable labor of compiling and reducing these has prevented their use. There are also some records, with rainfall included, of which the gagings are not considered very reliable, and which, for the present, are left untouched on that account.

In a report on the flow of the river Thames, by A. R. Binnie, chief engineer of the London county council,[a] the matter of negative evaporation is elaborately discussed, and in order to obtain all the information possible about it Mr. Binnie applied to George J. Symons, F. R. S., to assist him in arriving at some approximate idea on the subject. Mr. Symons submitted an exceedingly lucid and conclusive report. Eleven distinct cases of negative evaporation were submitted to him for study and comment. In regard to these he arrived at the following conclusions:

(1) Under normal conditions a fall of rain will increase the flow at Teddington weir on the second day after it falls.

(2) Under normal conditions the water running off from any given fall of rain will all reach Teddington weir before the tenth subsequent day.

(3) In the winter an interval of two months, or in extreme cases even more, may elapse between the precipitation of moisture from the clouds and its flow over Teddington weir.

[a] Report on the Flow of the River Thames, by A. R. Binnie. Publication of the London County Council, dated November 1, 1892.

As a consequence of (2) it is clear that a heavy rainfall on the last days of any month may not appear at the point of gaging until the next month. Mr. Symons also states that the one great fact which has been impressed upon him by these investigations is the great effect of winter frosts in regulating the flow of the river Thames and in mitigating winter floods.

These conclusions are more especially intended to apply to the river Thames. Hence, while it is true that so-called negative evaporation exists on all of the streams considered, the conditions are nevertheless very different, and in the United States the effect of holding back the flow of streams by frosts is in very many cases to precipitate a flood of water later on. This element would hardly be considered with us as either a river regulator or as mitigating floods.

GROUND WATER.

MOVEMENTS OF GROUND WATER.

In an extensive paper Prof. F. H. King has very clearly defined many of the underlying principles covering the movements of ground water.[a] In the beginning of his paper Professor King remarks that there is no single substance entering into the structure of the earth which has played and is playing so important a part as water. It penetrates the soils, sands, and rocks of the land areas in such large quantities that sand and sandstones lying below water level may contain as high as 38 per cent of their volume of water. Even the quantity stored in soil, gravel, and clay is very large. The water in a saturated soil or clay may range from 22 per cent up to 40 and even 50 per cent of its dry weight. The following table, giving the water capacity of undisturbed soils when lying below the plane of saturation, shows the amount of water which may be contained in various soils under natural conditions:

Water capacity of undisturbed soils.

Kind of soil.	Depth of layer.	Per cent of water.	Inches of water.
	Inches.		
Marly loam	0 to 12	41.3	5.88
Reddish clay	12 to 24	28.1	5.03
Do	24 to 36	28.4	5.07
Clay with sand	36 to 48	24.8	4.67
Very fine sand	48 to 60	17.4	3.76
Total			24.41

[a] Principles and conditions of the movements of ground water, by F. H. King: Nineteenth Ann. Rept. U. S. Geol. Survey, Part II.

Professor King states that there are many reasons for believing that water penetrates the fissures and interstices of the earth to depths even exceeding 10,000 feet. If the waters so inclosed form no larger part than 1 per cent of the weight of the material, with a specific gravity of 2.65, the amount of inclosed water would be sufficient to form an envelope 265 feet deep.

Moreover, Professor King's observations show that ground water is very easily disturbed and is constantly in motion. It responds readily to changes in barometer, temperature, etc. It is evident that these movements are not only closely related to the rainfall, the source of ground water, but that the run-off of streams is considerably influenced thereby.

GROWTH OF STREAMS BY ACCESSION OF GROUND WATER.

It is evident, without special discussion, that streams winding through the thread of a valley must receive accession to their volumes little by little as they move along. A few such, cited by Professor King, may be mentioned.

1. The Los Angeles River, in California, was measured in the winter of 1897–98, showing that in a distance of 59,088 feet (11.19 miles) the river increased in volume from 20.41 cubic feet per second to about 80 cubic feet per second. The width of the river will average perhaps 40 feet, and adding to this 5 feet on each bank, through which water may enter the stream, we have a seepage surface of 50 square feet per linear foot of length, whence we have a total seepage surface of 2,954,400 square feet. We have then for this particular case an average rate of seepage of 0.0000203 of a cubic foot per square foot per second.

This computation is made without reference to gradient, which is unknown.

A profile of the growth of the Los Angeles River is also given, which shows that the rate of accession is not uniform, but that much the larger portion of it takes place in the upper 47 per cent of the total length.

2. The West Los Angeles Water Company has a flume about 4,500 feet long sunk below the normal level of the ground water for the purpose of collecting the same and delivering it at the surface lower down the valley. The flume is described as being rectangular in cross section, 4 feet deep and 5 feet wide, with open bottom, but covered and provided with wooden sides.

On January 21, 1897, the flume was discharging 7.2 cubic feet per second; on November 19, 1896, 7.29 cubic feet per second: on March 1, 1896, 8.5 cubic feet per second; on November 23, 1895, it is said to have discharged 10.1 cubic feet per second, but in April, 1898, it was discharging 6.2 cubic feet per second.

3. The rate of seepage into the infiltration pipes of the Crystal

Springs Land and Water Company may be mentioned. This system consists of an east-and-west line of infiltration pipes sunk below the normal level of the ground water of the river valley, which join in their lower portion, when they deliver the water collected by them to the surface. The pipes are glazed sewer tile, laid double upon boards in the bottom of a ditch, the space immediately around them being filled with coarse gravel and sand, while above the gravel the cut is filled with material from the excavation. The east infiltration line has a total length of double tile consisting of 1,343 feet of 24-inch tile, 300 feet of 20-inch tile, 1,385 feet of 15½-inch tile, and 619 feet of 12-inch tile, making a total of 3,647 feet of double line. The west infiltration line, also double, has a measured length of 1,721 feet, all of 15-inch pipe.

The water discharged from the system on February 1, 1898, was 9 cubic feet per second, or a mean rate of 0.001677 of a cubic foot per second for each linear foot of length.

Professor King's paper includes the discussion of very many questions of great practical importance—as, for instance, the rate of filtration of water through soil, percolation of water into undisturbed field soil, rate of lateral flow through sands, time required to lower the ground-water level of a system of infiltration pipes, rate of flow of water into wells, flow of water into driven-well points, rate of pumping from driven well compared with rate from open well, and many others which, however, are not referred to here from lack of space. The paper is worthy of close attention from everybody interested in ground water.

The paper also includes a concise summary of what has been done by a number of European observers. A few papers on ground water have appeared since the publication of Professor King's, which, however, the writer has not seen.

In connection with the studies of Professor King, Prof. Charles S. Slichter undertook a theoretical investigation of the motion of ground water, and his paper also appears in the Nineteenth Annual Report of the United States Geological Survey.[a]

In this paper Professor Slichter studies the question mostly from the mathematical point of view. As an example of the nature of the problems touched by him the following may be cited:

Given, a uniform bed of unfissured sandstone 100 feet thick, lying between impervious layers and dipping 5 feet per mile; given, further, (*a*) a uniform temperature of 10° C.; (*b*) a pore space of 30 per cent; (*c*) an effective size of grain of 0.15 mm.; (*d*) an effective head of 10 feet, and, (*e*) supposing no cementing or clogging material between grains; required, the possible discharge in cubic feet per minute per foot of vertical section into a vertical fissure extending at right angles to the dip and constantly filled with water, when the fissure is 20, 40, 60, 80, 100, 120, 140, 160, 180, and 200 miles from the border of the collecting area.

[a] Theoretical investigation of the motion of ground waters, by Prof. Chas. S. Slichter: Nineteenth Ann. Rept. U. S. Geol. Survey (1897-98), Part II.

The rainfall on the catchment area is sufficient to maintain a constant overflow across its border.

The paper concludes with a list of about 80 titles of papers on ground water and related topics.

RELATION OF GEOLOGIC STRUCTURE TO RUN-OFF.

It is somewhat uncertain whether difference in soil due to difference in character of rocks has much influence on the run-off, although casually it appears that sandy soils, from their porousness, do considerably affect the result. Recent studies of this subject have shown (1) that in many river basins the annual run-off stands in a nearly constant relation to the rainfall, and (2) that this constancy is more marked when the excess rainfall above a certain minimum annual depth is considered. This latter statement is equivalent to saying that if the yearly rainfall is less than such minimum depth little or no run-off will take place.

The general truth of this proposition is shown by many Western streams where the run-off is little or nothing. In New Jersey 12 inches of rain during the summer season produce a run-off of 1.5 inches, though others have stated a somewhat different relation. In the State of New York from 1.7 to 2 inches may be considered the general range. As to the amount of rain required to produce any run-off at all, from 12.5 to 16.5 inches have been given. For this minimum many Western streams do not run more than 0.25 to 0.5 inch, and some even are perfectly dry. These statements indicate that the character of the soil, nature of vegetation, the elevation, etc., are of comparatively small importance as regards relation between the yearly volumes of rainfall and run-off. If, however, we consider the rainfall and run-off of the several periods, as shown by the accompanying tables, it is not entirely certain that these propositions are other than approximately true. The weight of evidence indeed is, on the whole, negative. Mr. Vermeule is disposed to attribute nearly all of the differences between streams to difference in geology, and accordingly gives a geologic classification for the New Jersey streams. Mr. Vermeule says:

> As a rule, the watersheds which lie upon the same geological formation will be found to have a strong resemblance, both in the character of flow and in the chemical composition of the waters.

Yet, as will be shown later, the Genesee and Oswego rivers, two streams with approximately the same run-off, lie mostly in different geologic formations. As regards quality of soils, Mr. Vermeule also says:

> It may be inferred that the kind of soil has much less to do with the amount of evaporation than has the temperature.

As regards the relation between geology and run-off, it is undoubtedly complicated, although it is interesting to note that in the State

of New York streams which flow from the north into Mohawk River, after crossing over a narrow strip of Trenton limestone and Calciferous sand rock, and which head in the Laurentian granite of the Adirondacks, have larger flows than those coming to the Mohawk from the south, which lie mostly in the horizon of the Hamilton shales, the headwaters of some of them—as for instance, Schoharie Creek—being in the sandstones of the Chemung and Portage groups. In their lower reaches they cross over the sandstones and shales of the Hudson and Utica groups, with narrow strips of Helderberg limestone, Oriskany sandstone, and Onandaga limestone.

However, there is another consideration. The headwaters of the streams to the north of the Mohawk nearly all lie in a region heavily timbered—some of it is still primeval forest—while those to the south are from a highly cultivated country, practically deforested.

We may now consider the case of Genesee and Oswego rivers, referring to the large geologic map of the State of New York, published in 1894, by James Hall, in cooperation with the U. S. Geological Survey.

Genesee River has an average rainfall of about 40 inches and Oswego River of about 37 inches. That portion of Genesee River which has been gaged lies almost entirely in the shales and sandstones of the Portage and Chemung groups. Oswego River, on the contrary, lies in the horizon of the Portage sandstones and shales, Hamilton shales, Onandaga and Helderberg limestones, Oriskany sandstone, the rocks of the Salina or Salt group, the Lockport limestone, Clinton limestone and shales, Medina sandstones, and Utica sandstones and shales, including the Oswego sandstone. The Chemung, Portage, and Hamilton formations have a wide outcrop, while the Onandaga, Oriskany, and Helderberg are comparatively narrow bands. The Salina, Lockport, Clinton, and Utica formations are all of considerable extent. Both of these streams are practically without forests, although slight exception to this statement may be noted on the extreme headwaters of the Genesee River in Pennsylvania, where there is still a small area of partially cut forest.

It is an interesting circumstance that the geologic formations in which the Genesee and Oneida rivers lie all have a slope to the south or southwest of from 10 to 30 feet per mile. The main trend of the Genesee River is south and north, while the two main branches of Oswego River—Seneca and Oneida—lie east and west. The Mohawk also flows from west to east. On this basis the Portage, Hamilton, Onandaga, Oriskany, Helderberg, and Salina groups lie mostly south of the Seneca and Oneida rivers, while a portion of the Salina, Niagara, Clinton and Medina groups lie mostly to the north. It is interesting, therefore, to speculate as to whether it is possible that considerable water escapes through these formations, finally appearing far to the south, but in the lack of any certain evidence this must be consideerd as merely a speculation.

It may be also noted that for tributaries of the Mohawk River lying to the north, the stratified formations—Utica shales, Trenton group, Calciferous sand rock, etc.—slope toward the stream, and hence may be expected, if there is anything in this view, to deliver more water than that merely due to the rainfall of the catchment as measured on the surface.

On the Upper Mohawk there is some evidence that this is true. The limestones here are open, and at several places streams on the surface sink, to reappear, in one case at any rate, with greatly increased volume several miles farther down. Again, at Howe's cave, in Schoharie County, there is a large stream of water flowing in the cave which, so far as known, does not appear anywhere on the surface.

Moreover, the Muskingum River may be referred to. This stream lies in the unglaciated region in southeastern Ohio, mostly in the horizon of the Conglomerate group of the Carboniferous. The main Muskingum River flows generally from north to south, with its main branches to the east and west, that to the west going a short distance into the Waverly group, which is chiefly sandstone and shale, a subdivision of the Carboniferous. The dip is from west to east. In view of the extremely low run-off of this stream, it seems tolerably evident that there can be no material contribution by percolation through these strata.

As other examples of underground flow, the writer may mention Toyah Creek, in Texas, where a stream of (his recollection is) 40 or 50 cubic feet per second flows from the base of a mountain with no indication as to its source. The well-known streams in Mammoth and Luray caves are doubtless familiar to all. There are also a number of river channels in the West where the water sinks into the porous soils, to reappear at some point lower down; but these are hardly allied to the cases under consideration, because the source is here visible.

A stream at Lausanne, Switzerland, may also be mentioned. In 1872 there was a serious epidemic of typhoid fever at Lausanne, Switzerland, which, on investigation, was found to proceed from a brook irrigating lands about a mile distant from a public well, from which the 800 inhabitants of the village mostly took their water supply. Ten years before, or in 1862, a hole had appeared in the channel of the brook at a certain point, 8 feet deep and 3 feet wide, which disclosed at its bottom a running stream, apparently fed by the brook from a point higher up. The brook itself was led into this hole, with the result that the water all disappeared and in an hour or two streamed out at the public well, showing a connection which had been suspected for years. On refilling the hole the brook returned to its bed.

After the epidemic had ceased in 1872 an investigation was held, the hole was reopened and a large quantity of salt thrown in, its pres-

ence in the public well was easily ascertained by a chemical examination.

This case discloses some points of interest. Here was a considerable stream flowing underground which was easily increased from the water of the brook, which was on the surface. Again, the flow here was through coarse gravel.

In the literature of canal construction there are a number of cases cited in which large losses of water have taken place either through coarse gravel or seamy rocks. Doubtless there are numerous other cases, which, however, are not specially important, for it is the writer's intention only to point out, in a general way, reasons why such losses may sometimes take place.

The outflow from Skaneateles Lake has been cited as showing a large loss, presumably by percolation through strata, but on reference to the original authority it is clear enough that an error has been made in so citing it, because the flow measured was really through 9 miles of natural channel and 8 miles of canal, to Montezuma. It may be mentioned that the problem to be determined by this measurement was the discharge into Seneca River and it is quite possible that there may have been a deficiency from the west.

Skaneateles Lake lies at an elevation of 867 feet above tide water and a distance of about 9 miles south of the Erie Canal, for which it has been used as a feeder since 1844. In 1859 Mr. S. H. Sweet made measurements of the flow to the canal and through the same to Montezuma, where the surplus water is discharged into Seneca River, to which it was found to deliver 125 cubic feet per second. Measurements were also made at the foot of the lake, where the flow amounted to 188 cubic feet per second. The loss was 63 cubic feet per second, or one-third of the whole. Skaneateles Lake itself lies in the Hamilton formation, and its outlet, on its way to the Erie Canal, flows across the Onondaga, Oriskany, Helderberg, and Salina formations. The dip is here from north to south, while the stream, which is tributary to the Seneca River, the main westerly branch of the Oswego, flows from south to north, or in the right direction to realize the maximum possible leakage, or percolation, through the strata. Inasmuch as no such leakage is mentioned, it may be reasonably concluded that none occurred.

Cazenovia Lake and Erieville reservoirs are also mentioned, and considerable loss of water is given, which when analyzed is found to be loss of water in the canal, and hence not in any degree attributable to leakage through strata. Cazenovia Lake and Erieville reservoirs both lie south of the Erie Canal, and flow across substantially the same strata as Skaneateles Lake.[a]

Such facts as these, while lacking the proof of a scientific demon-

[a] Ann. Rept. State Engineer and Surveyor for 1862, pp. 403-404.

stration, are still very interesting and indicate that we have yet much to learn of the peculiarities of stream flow. On the whole, while they undoubtedly point to a moderate loss from percolation, so far as the writer can see they do not indicate any great probability of very large loss from this cause. They do emphasize the fact that every catchment area will have its own formula.

By way of showing that the theory of large evaporation on deforested catchment areas is broadly more reasonable than the theory that there is any great loss of water by seepage owing to inclination of the strata, we may consider the Croton record as given by the appended Table No. 3, where it will be noted that the evaporation from this area is substantially the same as that from Muskingum and Genesee rivers; that is to say, it is the evaporation of a deforested area—the area in forest on this catchment does not exceed 10 per cent. In placing it at 10 per cent the writer means the equivalent in actual effect of dense forest. As regards geologic formation this catchment lies almost entirely in granites and gneisses, in which, from their homogeneous character, it is difficult to assume any loss by percolation through strata. There is, however, a small area of metamorphic Hudson formation, consisting of slate, schist, and quartzite, and also a small area of metamorphic Trenton and Calciferous limestones, but it is exceedingly improbable that any rocks which have been subjected to metamorphic changes are in any degree permeable. This watershed must therefore be considered as underlain by an impermeable formation. All of the water falling upon it except that absorbed by evaporation, chemical changes, etc., reappears as run-off in the streams. It may be safely assumed that there are no other losses. Nevertheless, the evaporation of this stream is that tentatively placed upon other deforested areas. Moreover, there is another interesting consideration of which brief note may be taken at this place. In deference to the water supply department of the city of New York, the writer has used in computing the monthly run-off the catchment area of 338.8 square miles. Mr. Vermeule, however, asserts that this area is not the true one. He says the true area above old Croton dam is 353.1 square miles. If we assume this to be true it follows that the average run-off, instead of being 22.8 inches, is over 4 per cent less, or is, roundly, 21.8 inches. This raises the evaporation from 26.6 inches to 27.6 inches. In his report on forests, Mr. Vermeule has placed the evaporation of his second Croton series, which the writer understands him to consider more reliable, at 22.6 inches, a difference of 5 inches from the foregoing figures, which it may be remarked is based upon the latest revision and is presumably more likely to be correct.

The catchment area of Lake Cochituate may be mentioned. According to Mr. FitzGerald, the slopes of the Cochituate catchment are flat and sandy, with a surface of mostly modified drift. The average rainfall for twenty-nine years, from 1863 to 1891, is 47.1 inches,

the average run-off 20.3 inches, and the evaporation for this period 26.8 inches. This evaporation places it at once in the category of deforested streams. Probably the equivalent of dense forest does not exceed 5 per cent.

The catchment area of Sudbury River has steeper slopes than that of Lake Cochituate and is largely composed of unmodified drift. The rainfall for twenty-six years is 1 inch less than on the Cochituate catchment, and the run-off 2.3 inches larger. The amount of forest does not exceed 6 to 8 per cent. Neshaminy Creek flows from north to south, emptying into the Delaware River not far from Bristol. For several miles its headwaters flow from west to east. Perkiomen Creek flows from north to south, and enters the Schuylkill River about 7 miles above the city of Norristown. Tohickon Creek flows from west nearly due east, although somewhat crooked for a few miles, then flowing in a southwesterly direction it reaches the Delaware River.

The surface of the ground is mostly farm land under a high degree of cultivation. The original forest growth has been almost entirely cut away, and the little remaining timber is found generally on the banks of the creeks, where the hillside is too steep to be cultivated, or on a few patches of bottom land. This growth is mostly composed of hickory, chestnut, oak, and ash. Even this is fast disappearing to supply the ever-increasing demand for railroad ties, fence posts, and rails. The proportion of cultivated lands, woodlands, etc., is as follows: Woodland, about 20 per cent; cultivated land, about 77.5 per cent; roads, 2 per cent, and flats, 0.5 per cent.[a]

On the upper Hudson River, with a catchment above Mechanicville of 4,500 square miles, the average rainfall for the fourteen years from 1888 to 1901, inclusive, was about 44.2 inches, the average run-off 23.3 inches, and the evaporation 20.9 inches. Above Glens Falls this stream lies almost entirely in the pre-Cambrian gneiss, from which it is improbable that there is any loss of water. Its main tributary to the west, Sacandaga, is, by observation, an exceedingly prolific water yielder. To the east, the Battenkill and Hoosic rivers have a different geologic history. The Battenkill flows across the Hudson shales, the Georgia limestones and shales, finally rising in the metamorphic Hudson and Trenton formations. The Hoosic River has a similar geologic history. The run-off of the Hoosic River is, without doubt, considerably less than that of the main Hudson. The average precipitation in western Massachusetts from 1887 to 1895, inclusive, was 38.98 inches, as against 43.29 inches in the northern plateau from 1889 to 1895, inclusive, a difference of 4.31 inches. Should such difference continue, the run-off of Hoosic River might be expected to be, on an average, about 20 inches. Moreover, the Hudson River above Glens Falls (catchment about 2,800 squares miles) is still largely in forest—probably about 85 per cent—but on

[a] Codman, John E., Observations on rainfall and stream flow in eastern Pennsylvania: Proc. Engrs. Club of Phila., Vol. XIV, No. 2, July-Sept., 1897.

the catchments of Wood Creek, Battenkill, and Hoosic rivers th proportion of forest is very much less—as an offhand estimate, th writer would say perhaps 20 to 30 per cent. The run-off of Schroo River, which is perhaps 70 per cent of an equivalent to fairly dens forest, is for four years 26.84 inches. There is, however, some doub whether this record is entirely reliable, and for the present it is no intended to more than merely call attention to the general propositio that this stream, which issues from an impermeable watershed witl 70 per cent of its catchment in forest, has a rather large run-off The whole catchment area of the Upper Hudson of about 4,500 squar miles, will probably not exceed 50 to 60 per cent of forest.

The following are the catchment areas of the several streams her considered: Hoosic, 711 square miles; Battenkill, 438 square miles Sacundaga, 1,057 square miles, and Schroon River, 570 square miles

The Pequannock River may also be referred to. This stream i characterized by sharp slopes throughout its whole extent. Its head waters are at an elevation of about 1,500 feet, while the mouth is only 170 feet above tide. The catchment is about 14 to 16 miles long by 4 t 7 miles wide. Mr. Vermeule states that its headwaters lie in th pre-Cambrian highlands. The sharp slopes, combined with smal catchment area, undoubtedly account for the relatively large run-of of this stream. There is also an uncertainty of 1 or 2 inches in th rainfall record. The catchment is judged by the writer to be 7 per cent forest.

In riding over the Pequannock catchment several times the writer was much struck by the fact that aside from the main valleys there are no gulleys throughout this area. The record shows that precipitation is frequently very heavy, but it has been thus far without effect. The indications appear to be that the rainfall, however intense it may be, sinks almost entirely into the ground, and without doubt this peculiarity has its effect on the run-off.

It may be pointed out that the geology of Muskingum and Genesee rivers is substantially the same, while the geology of Croton River and that of Lake Cochituate are entirely different. Nevertheless, when analyzed by aid of the diagrams (figs. 12–16, inclusive), these streams are seen to all have substantially the same evaporation and run-off, although the rainfall on Croton River and Lake Cochituate is different from that of Muskingum and Genesee rivers. Hudson River, however, which has much the same geology as Croton River and Lake Cochituate, has still a very different run-off and evaporation. Oswego River, which lies in a different formation from Genesee River, has still nearly the same evaporation.[a]

These several facts favor the view that deforestation is the real cause of the smaller run-off of Muskingum, Genesee, and Croton rivers and Lake Cochituate.

[a] The evaporation of Oswego River is, in fact, a little greater, due to the existence of large marsh areas on Oswego River.

EFFECTS OF FORESTS.

DO FORESTS INCREASE RAINFALL?

The evidence on this point is conflicting. The variation of the bserved from the true rainfall being so great, as has just been shown, he answer to this question must be regarded as very uncertain. It as been discussed by Professor Abbe and Dr. Hough.[a] The following summation by Dr. Hough, although made 26 years ago, may be ccepted as expressing the fact at the present day.

The reciprocal influences that operate between woodlands and climate appear o indicate a close relation between them. It is observed that certain consequences ollow the clearing off of forests, which can scarcely be otherwise regarded than s a direct effect, such as the diminution of rivers and the drying up of streams nd springs. Other effects, scarcely less certain, are seen in the occurrence of estructive floods, and of unseasonable and prolonged droughts, with other vicisitudes of climate which it is alleged did not occur when the country was covered vith forests. These appear to have been brought about by their removal, and night, in a great degree, be alleviated by the restoration of woodlands to a degree onsistent with our best agricultural interests.

On the other hand, there are many facts tending to show that the presence or bsence and the character of forests are the effect of climate, and that their cultiation generally, or the planting of particular species, is closely dependent upon . These conditions of climate should be understood before forest cultivation is ttempted. It is also to be noticed that differences of opinion have been expressed mong men of science as to the extent of influence that forests exert upon the limate, and it is quite probable that the advocates of extreme theories may have rred on both sides. But where principles depend upon facts that may be settled y observation, there should be no differences of opinion; and as there is no fact n this subject that may not be verified or disproved, the existence of such ifferences only shows the want of accepted evidence derived from trustworthy ecords.

The interested reader is referred to Dr. Hough's report, which may e easily obtained, for an extended discussion on this point.

EFFECTS OF FORESTS ON RUN-OFF.

The extent of forestation has probably a considerable effect on the un-off of streams. With similar rainfalls, two streams, one in a egion having dense primeval forests, the other in a region wholly or artially deforested, will show different run-off. The one with the ense forests will show larger run-off than the stream in the deforested rea. In some parts of the State of New York these differences may mount to as much as 5 or 6 inches in depth over the entire catchment rea. Yet it must be said that this proposition is, for the present, entative in its character.

The writer is particular to specify dense forests, because a good eal of discussion has clustered around this point. Of such forests,

[a] Report upon forestry, by Franklin B. Hough, U. S. Department of Agriculture (1877).

the most effective are those composed of spruce, pine, and other evergreen trees. Where the forest is more or less open to wind and sunshine, its effect, while considerable, is still much less marked than that of dense evergreen forests where the sun seldom penetrates and the wind effect, even in a gale, is only slight. On a catchment area where there are only scattered patches of forest, the effect is practically the same as on a deforested area. The same proposition is generally true on a catchment with young trees. What is wanted for the maximum effect is a mature evergreen forest.

This proposition, however, though definitely stated here, has been nevertheless the subject of considerable discussion, and owing to its complex nature, it is improbable that a final conclusion concerning it will very soon be reached. The writer has discussed this subject in various papers, which may be referred to for details that are mostly omitted here.[a]

WHY THE REMOVAL OF FORESTS AFFECTS STREAM FLOW.

Whatever question there may be as to the influence of forests on rainfall, there is, in the opinion of the writer, none as to such influence on stream flow. Yet this proposition has also been discussed pro and con and is likely to give rise to further discussion, and the conclusion will, therefore, for the present be considered tentative in its character.

It seems to the writer that the removal of forests decreases stream flow by allowing freer circulation of the air and by causing higher temperature and lower humidity in summer and so producing greater evaporation from water surfaces, as well as from the ground.

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[a] The following reports and papers are cited:

1. Three reports on Genesee River storage surveys: Appendixes to Ann. Repts. State Engineer and Surveyor for 1893, 1894, and 1896.

2. Two reports on Upper Hudson storage surveys: Appendixes to Ann. Repts. State Engineer and Surveyor for 1895 and 1896.

3. Water supply of the western division of the Erie Canal: Ann. Rept. State Engineer and Surveyor for 1896.

4. The economics of the Hudson River; lecture before the engineering classes of Rensselaer Polytechnic Institute, Feb. 24, 1897.

5. Stream flow in relation to forests: Proc. Am. Forestry Association, Vol. XII, 1897; also reprint in Ann. Rept. Fisheries, Game and Forest Commission (1896), published in 1898. Reprint 1898.

6. Natural and artificial forest reservoirs of the State of New York: Third Ann. Rept. Fisheries, Game, and Forest Commission (1897), published in 1899. Reprint, 1899.

7. Water Resources of the State of New York. Parts I and II: Water-Supply and Irrigation Papers U. S. Geol. Survey, Nos. 24 and 25, 1899.

8. On the application of the principles of forestry and water storage to the mill streams of the State of New York: Proc. Twenty-second Ann. meeting of Pulp and Paper Association. (1899.

9. Indian River dam, by Geo. W. Rafter, Wallace Greenalch, and Robert E. Horton: Engineering News, May 18, 1899. Reprint, 1899.

10. Data of stream flow in relation to forests; lecture before engineering classes of Cornell University, April 14, 1899; Trans. Association of Civil Engineers of Cornell University, Vol. VII 1899. Reprint, 1899.

11. A report on a water supply from the Adirondack Mountains for the city of New York Appendix E of an inquiry into the conditions relating to the water supply in the city of New York by the Merchants' Association, 1900.

12. Report to the Board of Engineers on deep waterways, on the water supply of enlarged canals through the State of New York; Appendix 16, pp. 571-950. (1901.)

That the removal of forests renders stream flow less equal throughout the year and so causes floods and periods of dryness in rivers seems to be beyond reasonable question, for the forest litter and root masses serve as storage reservoirs, tending to equalize the flow of streams.

Space will not be taken to discuss these propositions, because very little can be added to previous discussions. The reader is referred to the Bulletin No. 7, of the Forestry Division of the Department of Agriculture on Forest Influences, as well as to Dr. Hough's report on forests, for fairly complete discussions.

FORESTATION OF THE CROTON CATCHMENT AREA.

In a paper[a] read before the American Forestry Association in 1901, Mr. Vermeule proposes the question whether the forestation of the catchment area of the Croton water supply is advisable. In considering this question it may be pointed out that if the Croton watershed were forested, there is no probability of reaping the full benefit under from 75 to 150 years. On this point the following statement by Mr. B. E. Fernow, director of the New York State College of Forestry, at Cornell University, is pertinent:[b]

> The one thing in which the forestry business differs from all other business is the long-time element, for it takes 100 years and more to grow trees fit for the use of the engineer, the builder, and the architect; hence the dollar spent now in its first start must come back, with compound interest, 100 years hence.

For the sake of the argument, we will assume that on this watershed in 120 years the full effect of forestation would be realized. This would give, as an average, an increase of from 4 to 6 inches in run-off. For the purposes of this discussion we may assume it at 5 inches.

In order to forest the watershed it would be necessary to acquire the entire area, which, so far as the writer can ascertain, could hardly be done for less than $100 per acre. Probably the price would be much greater than this, but to avoid an overestimate it may be fixed at $100 per acre. At this rate the catchment area of 339 square miles would cost $21,696,000. The planting out of trees could hardly cost less than $20 per acre additional, but in order to make the estimate as reasonable as possible we will take it at $10 per acre, which makes an additional sum of $2,169,900, or a total of $23,865,900.

If we assume the annual interest at 3 per cent, and place this sum at compound interest for 120 years, we have at the end of that time the sum of $779,510,000. The present safe yield of the Croton watershed, with all available storage, is about 280,000,000 gallons per day. We would pay, therefore, this large sum for, perhaps, 75,000,000 gallons additional per day at the end of 120 years. It is true, there

[a] New Jersey forests and their relation to water supply, by C. C. Vermeule: The Engineering Record, Vol. XLII, No. 1 (July, 1901).

[b] The forester an engineer, by B. E. Fernow: Jour. Western Soc. Engrs., Vol. VI, No. 5 (Oct., 1901).

would be some increase in water supply after about 30 years, and the supply might be expected to go on increasing until the average increase of yield was attained in 120 years. But the increase in water supply would not be at all commensurate with the increase of capitalization. It is very evident that an expenditure of this sum of money would procure a far greater quantity of water from other sources. Hence it does not seem expedient to suggest the forestation of the Croton catchment area.

Another objection to the forestation of the Croton watershed as a remedy for the water difficulties of New York City may be found in the fact that a considerably increased water supply is wanted at once; it is entirely out of the question to wait 120 years for such increased supply.

As a broad proposition, however, catchment areas from which municipal water supplies are drawn should be in forests, and undoubtedly as time goes on this condition will be more and more attained. Already various European and American municipalities have recognized the advisability of owning the catchments from which their municipal water supplies are drawn.

DETAILS CONCERNING TABLES AND DIAGRAMS.

TOPOGRAPHIC RELATIONS OF CATCHMENT AREAS OF STREAMS TABULATED.

The following gives an outline of the topography of the several catchment areas included in the tables.

The headwaters of Muskingum River lie at an elevation of about 1,100 feet, and it flows into the Ohio River, near Marietta, at an elevation of about 500 feet. The Muskingum River proper has a length of 109 miles, with its main tributaries, the Walhonding and the Tuscarawas, having an additional length of about 100 miles, thus giving the basin a length of 200 miles. From the head of the Tuscarawas to the junction of the two main tributaries there is a fall of about 2 feet per mile, and from this point to the mouth of the main Muskingum the descent is about 1.5 feet per mile. On the Walhonding the descent is more rapid. At its headwaters, near Mansfield, the stream is from 400 to 450 feet above what it is at its junction with the Tuscarawas.

The Genesee River rises in Potter County, Pa., and flows in a northerly direction across the State of New York, emptying into Lake Ontario at Rochester, having a total length of about 115 miles. Its headwaters are at an elevation of over 2,000 feet, while Lake Ontario lies at a mean elevation of 247 feet. This stream is specially characterized by two sets of falls. The three falls at Portage have an aggregate of about 270 feet, while at Rochester the river falls 263 feet, also in three falls, with some intervening rapids. This stream flows for several miles at Rochester and Portage over bare rocks.

The Croton River flows into the Hudson at Croton Landing at an elevation of practically tide water. Its extreme headwaters in Dutchess County are at an elevation of about 700 feet above tide. Its length is about 35 miles.

Lake Cochituate is in a generally flat area at an elevation of about 200 feet above tidewater. A small area in the south portion rises to an elevation of 300 feet. The greatest extent of this area is from northeast to southwest, about 9½ miles, with an average width of about 2 miles. In the northern part it is narrower than this and in the southern somewhat greater.

Sudbury River catchment area lies immediately to the west of the Lake Cochituate catchment. The elevations vary from about 200 feet above tide to from 500 to 600 feet. Its length from north to south is about 10 miles, and from east to west about 8 miles. Owing to a number of hills throughout the area the slopes are much steeper than on the Cochituate catchment. Sudbury catchment lies about 25 miles to the west of Boston.

Mystic Lake is practically at sea level, with considerable hills in a portion of the catchment area. The slopes are steep, but not quite as steep as Sudbury.

Neshaminy Creek flows into the Delaware River at an elevation of from 10 to 20 feet above tide water. Its headwaters are at an elevation of about 300 feet. Its extreme length from north to south is from 40 to 45 miles.

Perkiomen Creek flows into the Schuylkill at an elevation of about 75 feet above tide level. The headwaters are at an elevation of 550 feet. The length of the basin from north to south is about 30 miles.

Tohickon Creek flows into the Delaware River at an elevation of about 70 feet above tide. Its extreme headwaters are at an elevation of 525 feet. Its length, from east to west, is about 25 miles.

Hudson River, at Mechanicville, is about 60 feet above tide, while at its extreme headwaters it is about 3,400 feet above tide level. The catchment area above Glens Falls is from 40 to 50 miles from east to west and from 60 to 65 miles from north to south. Below Glens Falls the catchment extends well into southern Vermont and Massachusetts. The length of the stream above Mechanicville is from 120 to 125 miles.

Pequannock River flows into the Passaic near Pompton, at an elevation of 170 feet above tide. The main facts of the topography of this stream have been given in the chapter on "The relation of geology to the run-off of streams."

The Connecticut River flows into Long Island Sound at tide water, and rises in the northern part of New Hampshire. Its extreme headwaters issue from an elevation of 2,000 to 3,000 feet above tide level. Its length is about 375 miles. The topography of this catchment is hilly and, in the northern part, mountainous.

CLASSIFICATION OF STREAMS.

In Table No. 13 we have the mean rainfall, run-off, and evaporation of the storage, growing, and replenishing periods of the streams for which individual figures are given in Tables Nos. 1 to 12, inclusive. This table shows what may be termed the family resemblance between streams. For instance, for the Muskingum and Genesee rivers the mean rainfall of the storage period is about 19 inches, with a run-off of about 10 inches and an evaporation of about 9 inches. For the growing period the mean rainfall of each of these two streams is about 12 inches, with run-off 1.7 inches and evaporation 10 inches. For the replenishing period the mean rainfall of each is about 9 inches, with run-off about 2 inches and evaporation 7.5 inches. The total rainfall of the whole year is 40 inches for each stream—run-off 13.5 inches and evaporation 26.5 inches.

The Croton River has a much higher rainfall. Twenty-four inches in the storage period produces 17 inches of run-off, with an evaporation of 7 inches. From 13.6 inches of rain in the summer we have 2.6 inches of run-off, with 11 inches of evaporation. The rainfall for the year is 49.4 inches, or, say, 9 inches more than for Muskingum and Genesee rivers. The run-off is also about 9 inches in excess of that of these two streams. The evaporation is, however, the same, pointing very strongly to a similar cause.

On Lake Cochituate catchment 23.1 inches rainfall in the storage period produces on an average but 14.9 inches of run-off, with 8.2 inches of evaporation. The rainfall of the growing period is the same as that of the Muskingum and Genesee rivers, yielding, however, 2.1 inches run-off and 9.5 inches evaporation. For the replenishing period, 12.4 inches rainfall yields 3.3 inches run-off, with 9.1 inches evaporation. The totals for the year are, rainfall, 47.1 inches; run-off, 20.3 inches, and evaporation, 26.8 inches. Aside from difference in catchment areas, the total evaporation of both Croton River and Lake Cochituate is substantially the same as that of Muskingum and Genesee rivers. The excess rainfall of Lake Cochituate over Muskingum and Genesee rivers is about the same as the excess evaporation; that is to say, 7.5 inches. As regards evaporation, Lake Cochituate may therefore class with the Muskingum, Genesee, and Croton rivers.

For Sudbury River, Mystic Lake, Neshaminy and Perkiomen creeks, somewhat different conditions prevail. The yearly evaporation is here about 24 inches, and, with the exception of Mystic Lake, the run-off is about 23 inches. On Mystic Lake catchment the rainfall is enough smaller to fully account for the difference in run-off. Broadly, these four streams may be considered as making a second class.

Tohickon Creek has a total annual mean rainfall of 50 inches, from whence it results that the mean yearly run-off is 28.4 inches and the

evaporation 21.7 inches. This stream varies so much, from what the general principles indicate, that the writer doubts somewhat the correctness of the record. He considers it quite possible that it may be 10 per cent to 20 per cent in error. Reasons for this view are given in the chapter on "Negative evaporation." The writer recognizes, however, that in view of the uncertainty of gagings, etc., the mere fact of a stream not squaring with preconceived views ought not to condemn its record. There must be valid reasons for rejecting the particular record.

The Hudson River shows apparently the effect of an impermeable catchment, combined with a large forest area. It has a mean annual rainfall of 44.2 inches, yielding 23.3 inches run-off, with 20.9 inches evaporation. For the storage period 20.6 inches rainfall yields 16.1 inches run-off, with 4.5 inches evaporation. For the growing period 12.7 inches rainfall yields 3.5 inches run-off, with 9.3 inches evaporation. For the replenishing period 10.9 inches rainfall yields 3.7 inches run-off and 7.1 inches evaporation. This stream, from general similarity, may properly classify with the Connecticut.

For the Pequannock River explanations have already been given, which apply generally. For the present it tentatively stands in a class by itself.

The classification here given is experimental merely, and is subject to modification with the gathering of more complete data.

DESCRIPTION OF TABLES NOS. 1 TO 12.

Table No. 1 gives the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods, as well as the total of these three items, on the Muskingum River, for the years 1888–1895, inclusive. The minimum year was 1895, the total run-off being 4.90 inches. The maximum occurred in 1890, with a total run-off of 26.84 inches. The mean run-off for the entire period is 13.1 inches.

Table No. 2 gives the same facts for the Genesee River for the years 1890–1898, inclusive. In this table, for the years 1890–1892, the record of Oatka Creek, which was gaged by the writer, has been used. For a portion of 1893, the results are computed. The dam at Mount Morris, at which gagings were taken, was carried away by a flood early in 1897, and for the years 1897 and 1898 the gaging record has been deduced by comparison of the rainfalls with those at Rochester, where gagings are kept by the city engineer. The results, aside from those for the years 1894–1896, must be considered somewhat approximate, although probably within 10 per cent of the truth. The mean evaporation for the years 1894–1896 was 27.21 inches.

Table No. 3 exhibits the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods for Croton River, from 1868–1899, inclusive, a period of thirty-two years. This record has

been revised as per experiments at Cornell University, described by John R. Freeman, member American Society Civil Engineers, in his report to the comptroller in 1900. As shown by Mr. Freeman, the rainfall record from 1868–1876, inclusive, is not very reliable, and accordingly two sets of means are given. The mean rainfall from 1868–1876, inclusive, was 45 inches, the mean run-off 23.37 inches, and the mean evaporation 21.63 inches. For the second period the rainfall from 1877–1899, inclusive, has been so rationally treated by Mr. Freeman as to leave nothing to be desired. The means for this second period are: rainfall, 49.33 inches; run-off, 22.81 inches, and evaporation, 26.52 inches. A comparison of these two sets of means shows how dangerous it is to draw final conclusions from data about which there is considerable doubt. The rainfall differs by 4.33 inches and the evaporation by 4.89 inches, or from 20 per cent to 25 per cent.

In preparing this table the figures of table No. 26 of Mr. Freeman's report have been used. This table is in million gallons per 24-hour day, and has been reduced to inches per month on the catchment area of 338.8 square miles. The following gives the water surfaces exposed to evaporation at different periods:

	Per cent.
5.8 square miles, 1868–1873,	= 1.73
6.2 square miles, 1873–October, 1878,	= 1.83
6.9 square miles, 1878–1891,	= 2.03
8.4 square miles, 1891–1893,	= 2.48
9.5 square miles, 1893–1895,	= 2.82
11.0 square miles, 1895–1897,	= 3.28
12.0 square miles, 1897–1900,	= 3.56

It may at first thought be imagined that these large water sufaces exposed to evaporation have considerably increased the ground evaporation over the entire catchment. When, however, one considers that it is only the difference between what a water-surface evaporation and what a ground-surface evaporation would be, the difference is seen to be not very much. For instance, assuming the water-surface evaporation at 36 inches per year and the ground-surface evaporation at 27 inches per year, the difference becomes 9 inches. With 12 square miles of water surface in 1900, giving 3.56 per cent of the whole, the excess of water-surface evaporation over ground-surface evaporation is 0.32 of an inch, a quantity which is so far within the limit of possible error in other directions as to be negligible. At the most, taking the assumed catchment area at 338.8 square miles, it would only reduce the evaporation from 26.5 inches to 26.2 inches.

The minimum year in this table is seen to be 1880, when only 13.71 inches ran off. In 1883 the run-off was also very low, being only 13.74 inches.

Table No. 4 exhibits a similar set of facts for Lake Cochituate from 1863–1900, inclusive. Two sets of means are also given in this case,

one from 1896–1900, a period of 5 years, and the other from 1863–1900, a period of 38 years. There is very little difference between these two sets of means. The minimum year is seen to have been 1883, when there was only 10.09 inches of run-off.

Table No. 5 gives the same data for Sudbury River from 1875–1900, inclusive, a period of 26 years. Two sets of means, one for the five years from 1896–1900, inclusive, and the other for the entire period of 26 years, are also given in this case. The catchment area of this stream is hilly, and considerable variation in rainfall may be expected to take place. Originally only one rain gage was exposed, but latterly there are several, and the rainfalls as given in the table are the means of these. In 1883, which was the year of minimum run-off, only 11.40 inches appeared in the stream, out of a total precipitation of 31.52 inches.

According to the Sixth Annual Report of the Metropolitan Water Board, rainfall observations for Sudbury catchment were taken as follows: January, 1875, to April, 1876, Lake Cochituate only; April to June, 1876, Lake Cochituate, Westborough, and Hopkinton; June to December, 1876, Lake Cochituate, Southborough, Marlborough, Westborough, and Hopkinton; December, 1876, to January, 1883, Framingham, Southborough, Westborough, Marlborough, and Hopkinton; January, 1883, to January, 1884, Framingham and Southborough; January, 1884, to January, 1890, Framingham and Westborough; January, 1890, to May, 1898, Framingham and Ashland dam; June, 1898, to December, 1900, Framingham, Ashland dam, Cordaville, and Sudbury dam.

The catchment area of Sudbury River, from 1875–1878, inclusive, was 77.764 square miles; in 1879 and 1890 it was 78.238 square miles, and from 1881–1900, inclusive, 75.2 square miles.

On Sudbury catchment water surfaces were 1.9 per cent of the whole from 1875–1878, inclusive; they were 3 per cent in 1879, 3.4 per cent in 1885, 3.9 per cent in 1894, and 6.5 per cent in 1898. The catchment also contains extensive areas of swamp land, which, although covered with water at times, are not included in the above percentages of the water surfaces.

Table No. 6 gives the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods for Mystic Lake catchment, from 1878–1895, inclusive, a period of 18 years. The minimum year, with a total run-off of 9.44 inches, occurred in 1883. Since it is the run-off of the minimum year which determines the value of a stream for water supply, this figure shows that this stream is not, on the whole, as good a water yielder as Lake Cochituate and Sudbury catchments.

Table No. 7 gives the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods for Neshaminy Creek for the

years 1884–1899, inclusive, a period of 16 years. The minimum year was 1895, when, with a rainfall of 38.59 inches, 18.15 inches ran off. Neshaminy Creek may be taken as a deforested area.

Table No. 8 gives for Perkiomen Creek the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods for the 16 years from 1884–1899, inclusive. The minimum year was 1895, when, with 40.35 inches rainfall, the run-off was 17.58 inches. The writer's recollection is that in riding through this area some time ago, the forest is mostly scattered and is probably equivalent in effect to not more than 8 per cent to 10 per cent of dense forest. If he is wrong in this, he will be glad to be set right.

Table No. 9 gives for Tohickon Creek the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods from 1884–1898, inclusive, a period of 15 years. The year of minimum run-off was 1896, when 48.03 inches of rainfall yielded 19.73 inches of run-off. The rainfall of this catchment is considerably higher than that of the two contiguous streams, from whence it results that the run-offs are also larger.

Table No. 10 gives the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods for the Hudson River area for a period of 14 years, from 1888–1901, inclusive. The minimum year was 1895, when 36.67 inches of rainfall yielded 17.46 inches as run-off in the stream.

Table No. 11 gives the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods of the Pequannock River catchments for 9 years, from 1891–1899, inclusive. The minimum year was 1895, when, with 37.92 inches of rainfall, 21.11 inches appeared as run-off. The rainfall record for this catchment area is not entirely satisfactory and further study may modify it somewhat.

Table No. 12 gives the rainfall, run-off, and evaporation of the storage, growing, and replenishing periods for the Connecticut River at Hartford for a period of 14 years, from 1872–1885, inclusive. The minimum year was 1883, when, with 32.55 inches of rainfall, 12.61 inches ran off. The record, however, of the year 1883 is that of Holyoke, Mass., the years 1882 and 1883 not being given in Mr. Babb's paper, from which these data are otherwise taken. For these years the rainfall has been computed and is, of course, approximate.

Moreover, the record of Connecticut River as a whole can not be deemed very satisfactory, either as regards the rainfall or the run-off. The run-off is probably anywhere from 5 per cent to 20 per cent in excess and a considerably larger number of stations should be averaged to give safe rainfall. The record at Holyoke from 1880–1899, inclusive, is considered much more satisfactory, but unfortunately this record is not accompanied by the rainfall, and thus far the writer has not had an opportunity to obtain these.

DESCRIPTION OF DIAGRAMS

We may now consider a few of the large number of diagrams which have been prepared.

Fig. 1 shows, for the Upper Hudson, precipitation, evaporation, run-off, and mean annual temperature for the years 1888–1890, inclusive, plotted in the natural order.

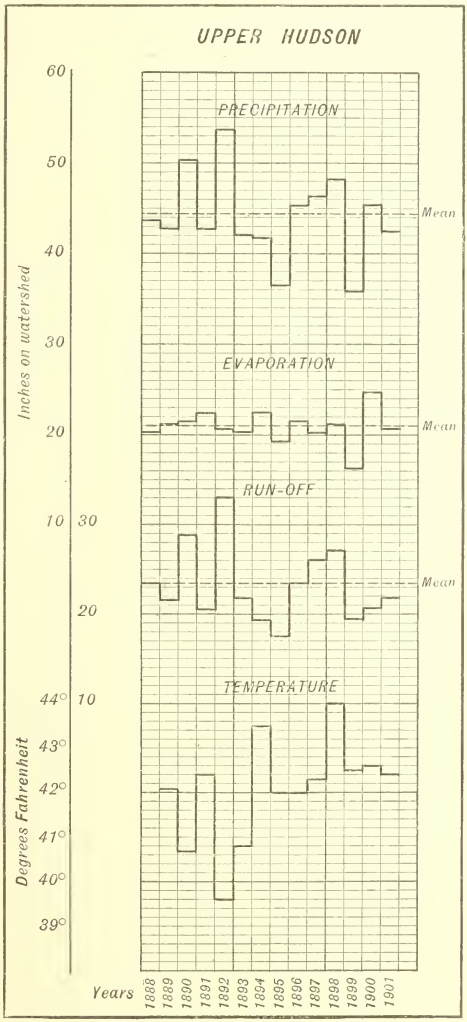


FIG. 1.—Diagram showing relation between precipitation, evaporation, run-off and temperature on the Upper Hudson River.

Fig. 2 shows, for the same area, evaporation and mean annual temperature, plotted in the order of the evaporation.

Fig. 3 shows, for the Upper Genesee, precipitation, evaporation, run-off, and mean annual temperature, plotted in the order of the precipitation.

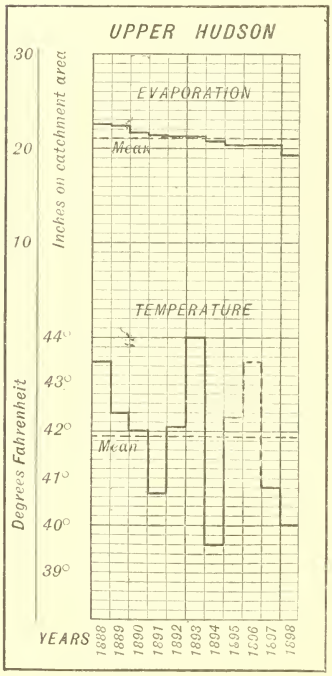


FIG. 2.—Diagram showing the relation between evaporation and temperature on the Upper Hudson River, the years being arranged according to the amount of evaporation.

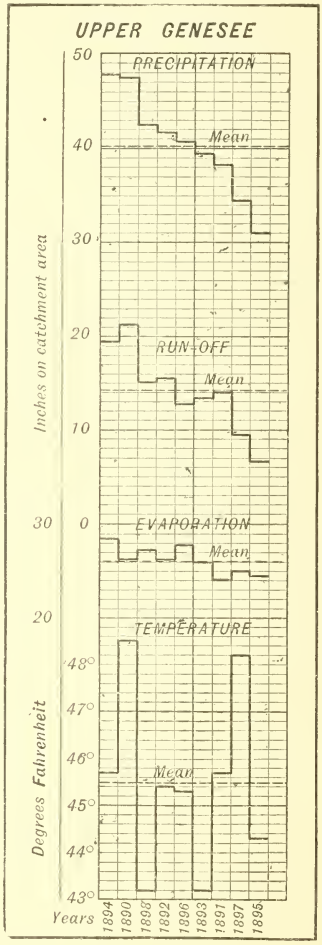


FIG. 3.—Diagram showing the relation between precipitation, run-off, evaporation, and temperature on the Upper Genesee River, the years being arranged in order of dryness.

Fig. 4 shows, for Sudbury River, precipitation, evaporation, run-off, and mean annual temperature, plotted in the natural order.

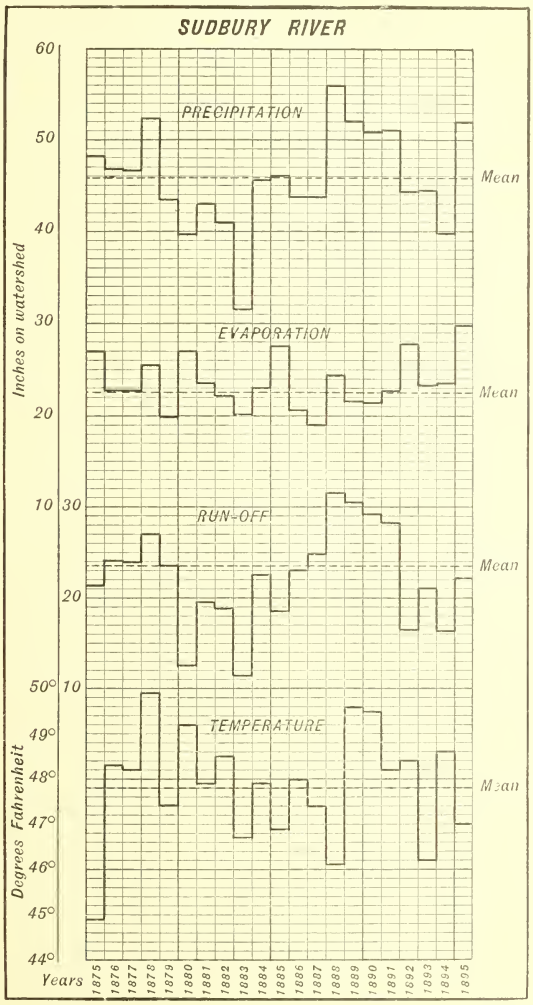


FIG. 4.—Diagram showing the relation between precipitation, evaporation, run-off, and temperature on the Sudbury River, Massachusetts.

On fig. 5 we have, for the same stream, precipitation, evaporation, run-off, and mean annual temperature, plotted in the order of the precipitation.

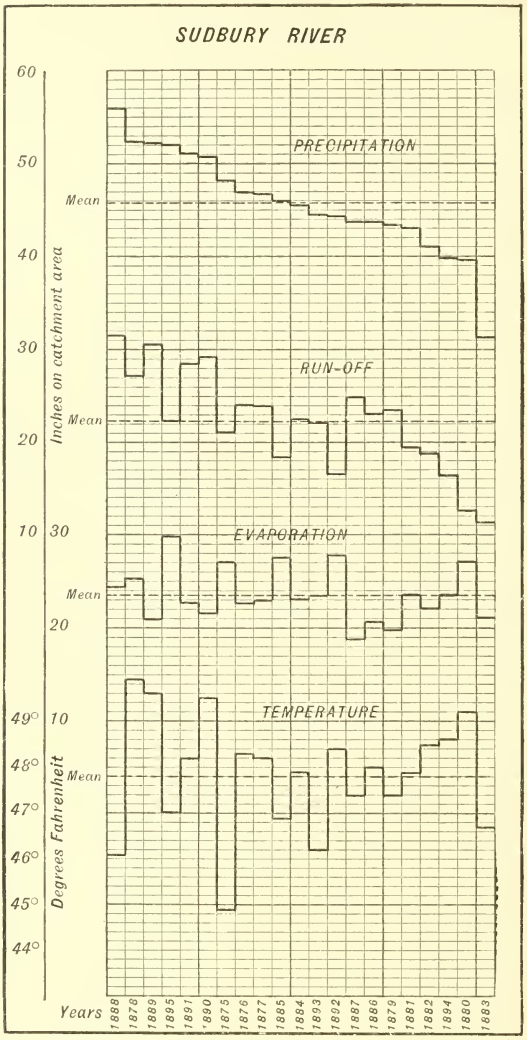


FIG. 5.—Diagram showing relation between precipitation, evaporation, run-off, and temperature on the Sudbury River, Massachusetts, the years being arranged in order of dryness.

On fig. 6 we have, also for Sudbury River, evaporation and mean annual temperature, plotted in the order of the evaporation.

Fig. 7 shows, for the Muskingum River, precipitation, evaporation, run-off, and mean annual temperature, plotted in the order of the precipitation.

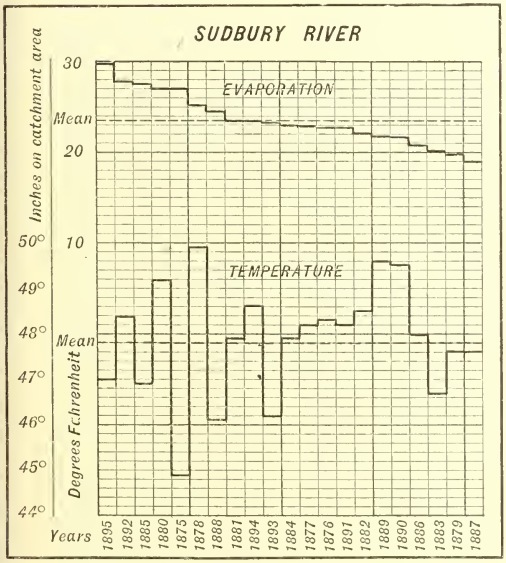


FIG. 6.—Diagram showing the relation between evaporation and temperature on the Sudbury River, the years being arranged according to the amount of evaporation.

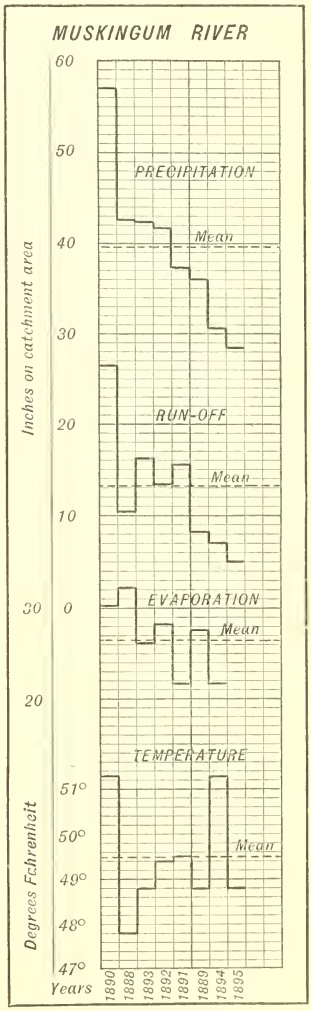


FIG. 7.—Diagram showing the relation between the precipitation, run-off, evaporation, and temperature on the Muskingum River, Ohio, the years being arranged in order of dryness.

Fig. 8 shows, for Lake Cochituate, precipitation, evaporation, run-off, and mean annual temperature, plotted in the order of the precipitation.

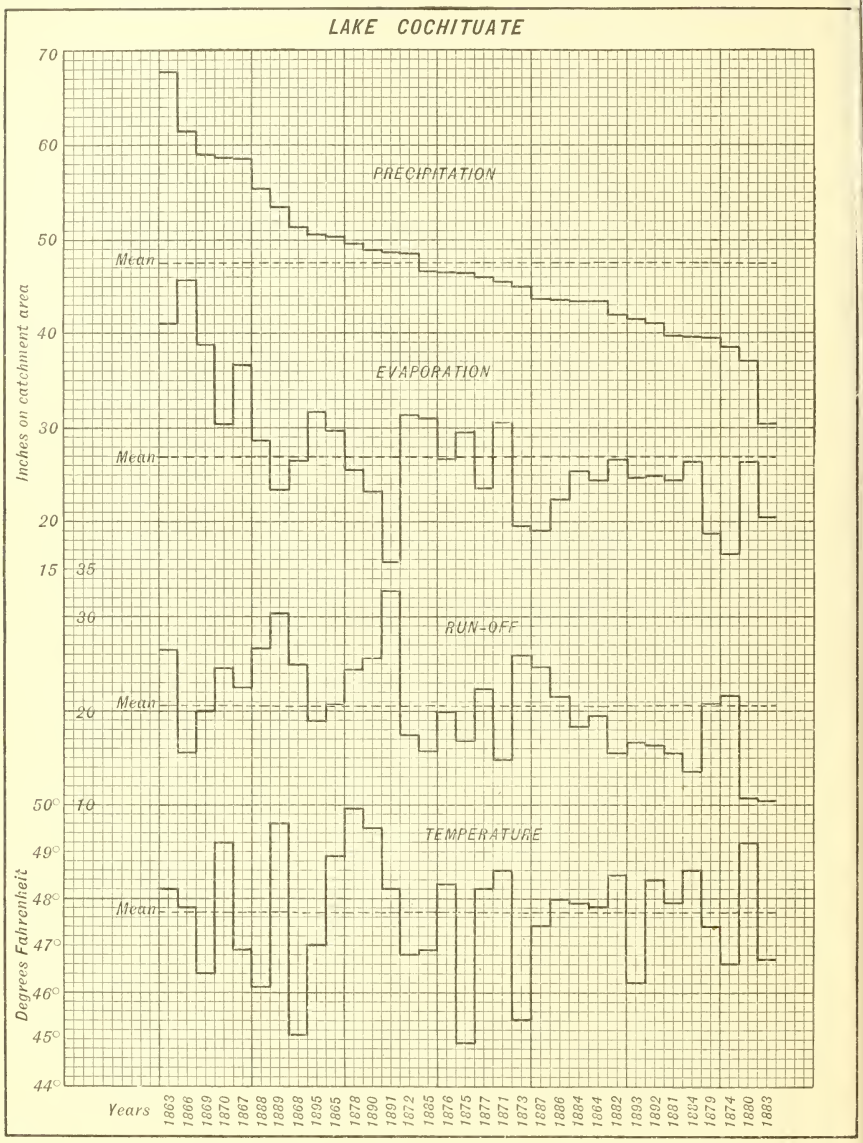


FIG. 8.—Diagram showing the relation between the precipitation, evaporation, run-off, and temperature in the Lake Cochituate Basin, the years being arranged in order of dryness.

Fig. 9 shows, for Lake Cochituate, evaporation and mean annual temperature, plotted in the order of the evaporation.

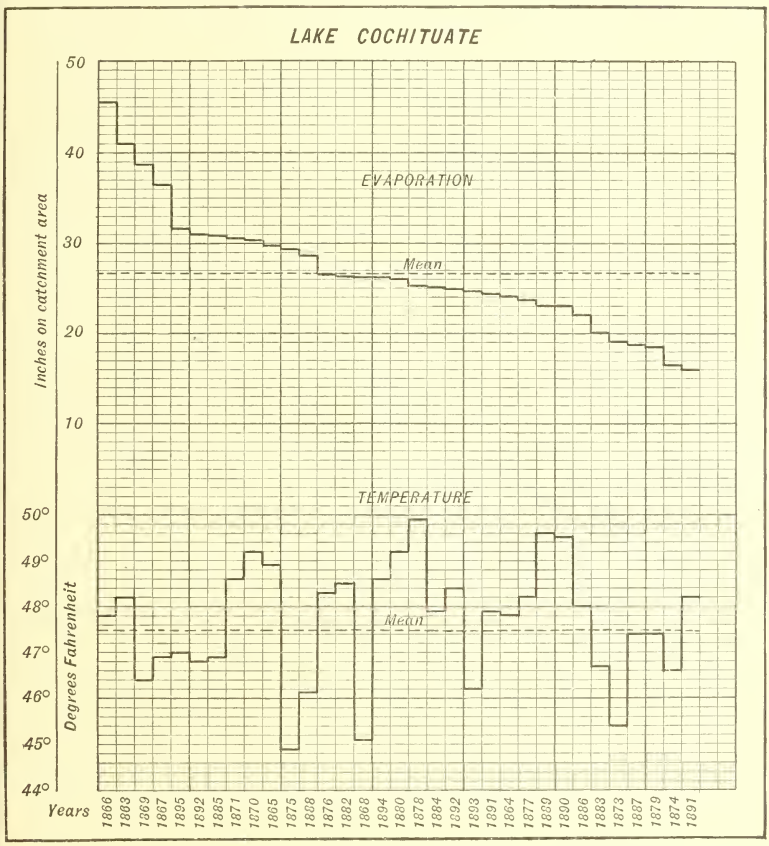


FIG. 9.—Diagram showing the relation between evaporation and temperature in the Lake Cochituate Basin, the years being arranged according to the amount of evaporation.

On fig. 10 the relation between precipitation and run-off, for the Upper Hudson, has been expressed by the formula $P^2=84.5$ R. These diagrams (figs. 1 to 10) all show, together with many others not here published, that there is no definite relation between evaporation and mean annual temperature.

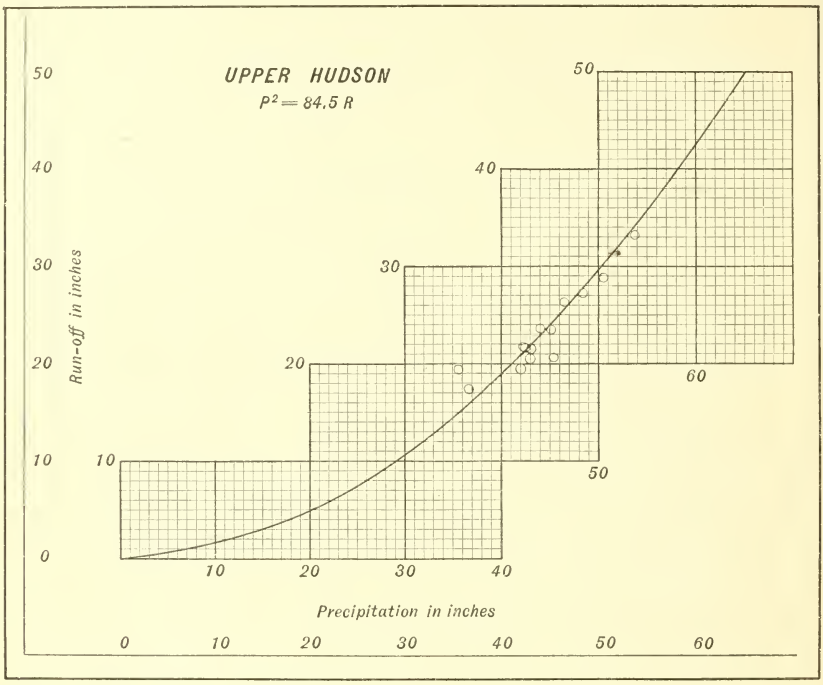


FIG. 10.—Diagram showing the relation between the precipitation and run-off in inches on the Upper Hudson River.

EXPONENTIAL FORMULA.

On fig. 11 this relation is expressed by an exponential formula, after the manner proposed by Mr. FitzGerald in his paper, "Flow of water in 48-inch pipes."[a] Such a curve has the advantage that it is the best approximation possible to obtain from the given data. It will be noticed that it differs slightly from the curve of fig. 10. At 30 inches rainfall this difference amounts to about 1.3 inches of run-off.

While on the subject of exponential formulas it may be remarked that their chief advantage lies in the possibility of taking any set of data and deducing the curve which best suits the conditions.

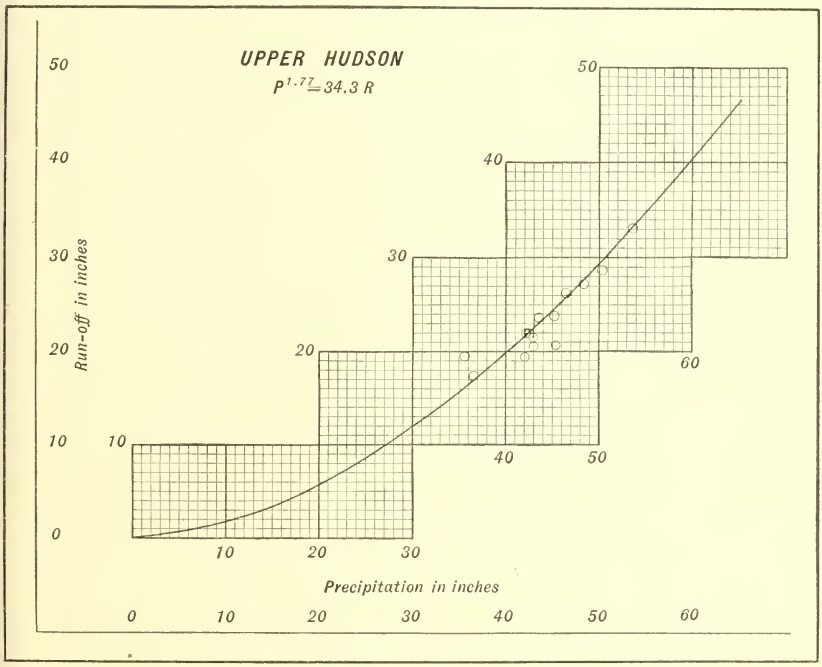


FIG. 11.—Diagram showing the relation between the precipitation and run-off in inches on the Upper Hudson River, expressed by exponential formula.

DESCRIPTION OF RUN-OFF DIAGRAMS.

Fig. 12 is a run-off diagram of Hudson and Genesee rivers, Hudson River for 1888-1901, inclusive, and Genesee River for 1890-1898,

[a] Trans. Am. Soc. C. E., Vol. XXXV, p. 241.

inclusive. In preparing this and the following diagrams it is considered that if both run-off and precipitation were correctly measured the points would fall in a regular curve approximately like those shown on figs. 10 and 11. Such diagrams may therefore be taken as a criterion of the accuracy with which the observations have been made. It is easier, however, to measure the run-off than it is to measure the precipitation, and hence when large variation occurs, as it does in these several diagrams, we may first look for it in the precipitation records. As regards the Hudson area, it has been the writer's custom to take the rainfall of the northern plateau of the State weather bureau as, on the whole, best representing the rainfall of the Upper Hudson area. With the exception of the years 1899 and 1900 the points all fall within from an inch to an inch and a half of the curve. Those two years have, however, been computed by a less accurate method than the preceding ones. It is concluded, therefore, that aside from 1899 and 1900 the curves represent the rainfall and run-off of Hudson and Genesee rivers with considerable accuracy.

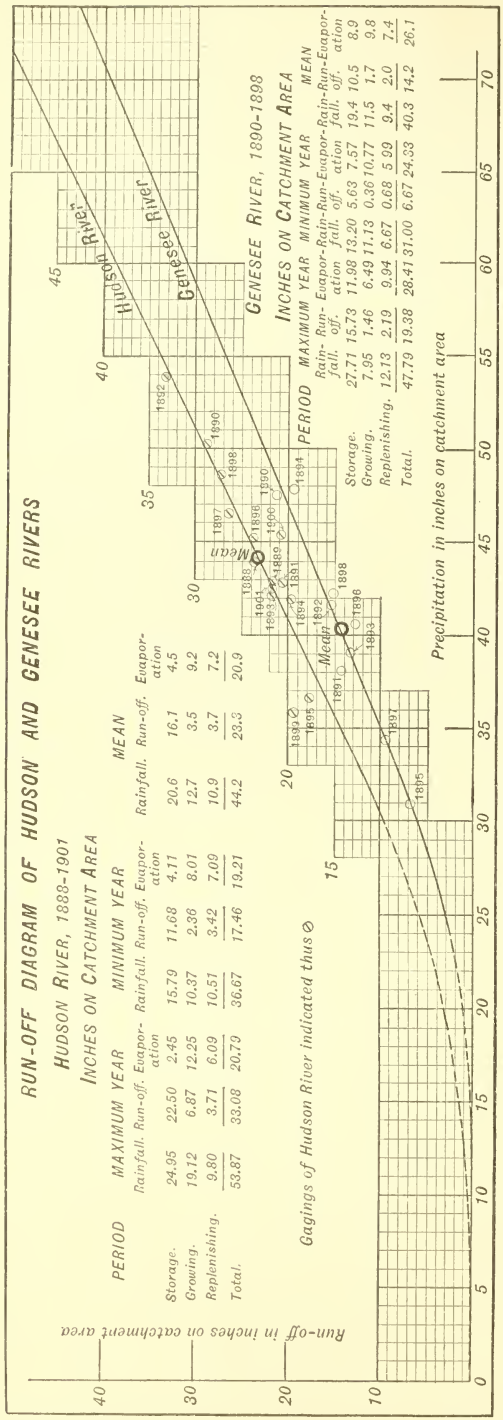


FIG. 12.—Run-off diagram of Hudson and Genesee rivers.

Fig. 13 shows in a similar manner a run-off diagram for Muskingum River from 1888 to 1895, inclusive.

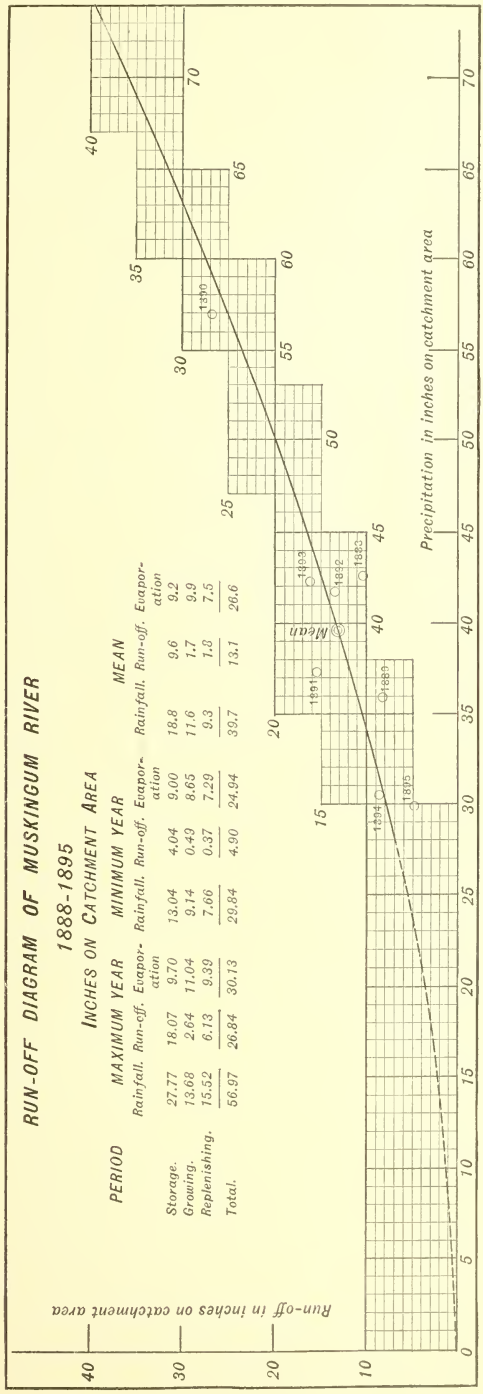


FIG. 13.—Run-off diagram of Muskingum River.

Fig. 14 is a similar diagram for Passaic River from 1877 to 189 inclusive.

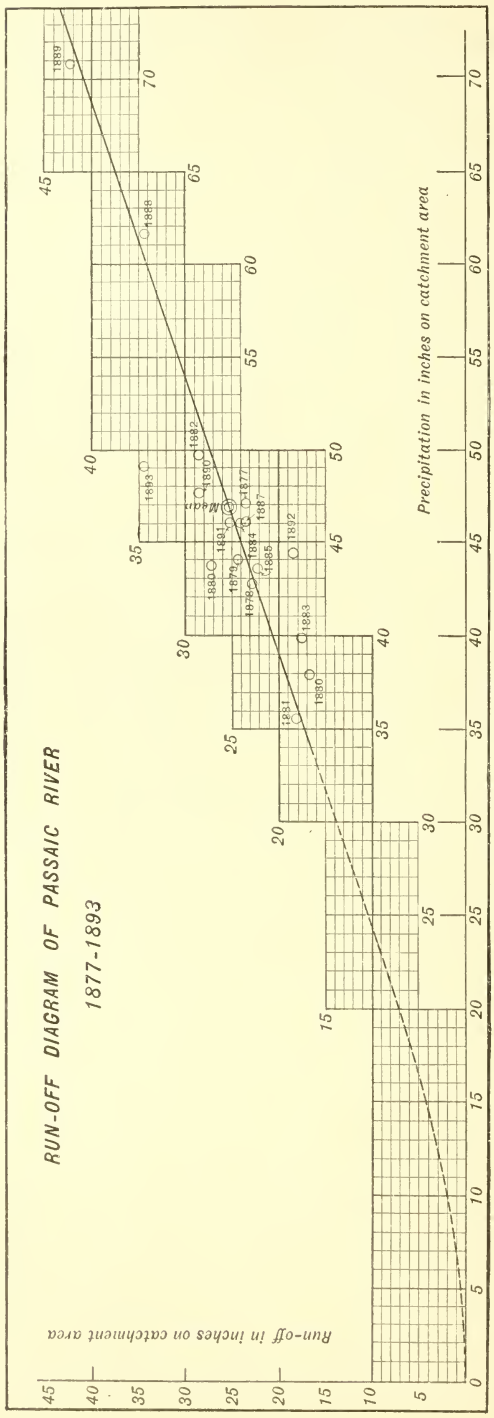


Fig. 14.—Run-off diagram of Passaic River.

Fig. 15 is a similar diagram of Sudbury River from 1875 to 1900, inclusive.

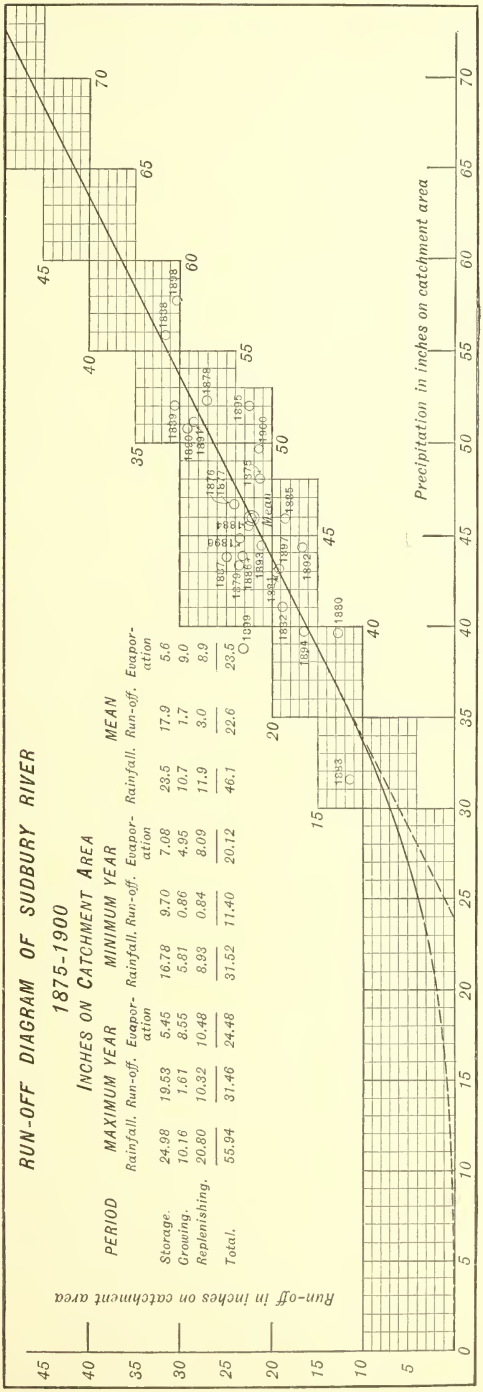


FIG. 15.—Run-off diagram of Sudbury River.

Fig. 16 is a diagram of the revised gagings of Croton River from 1877 to 1899, inclusive

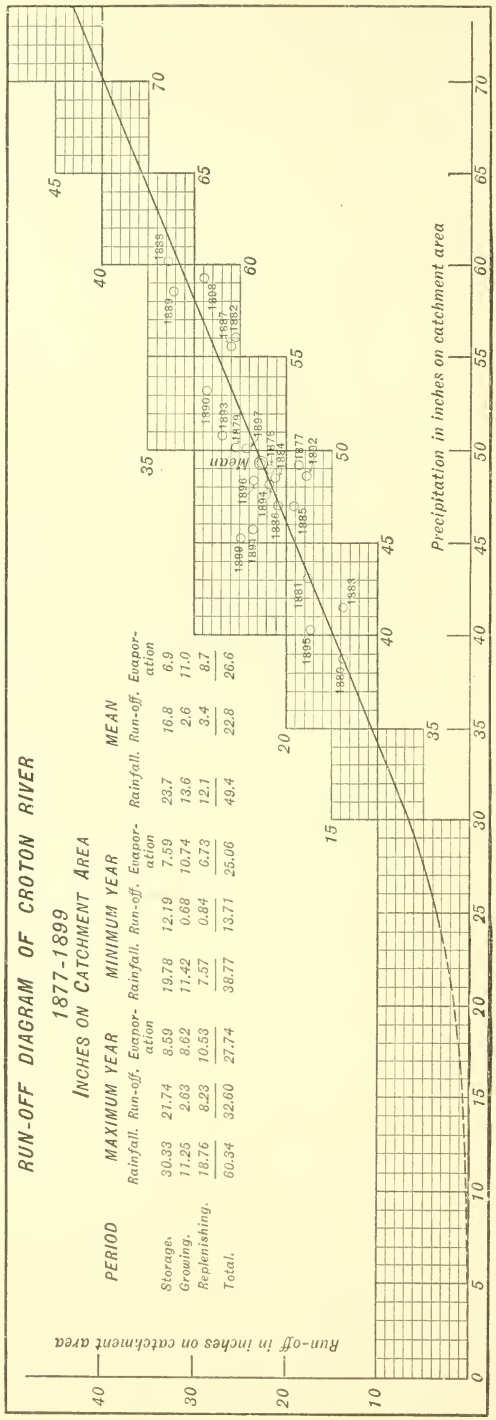
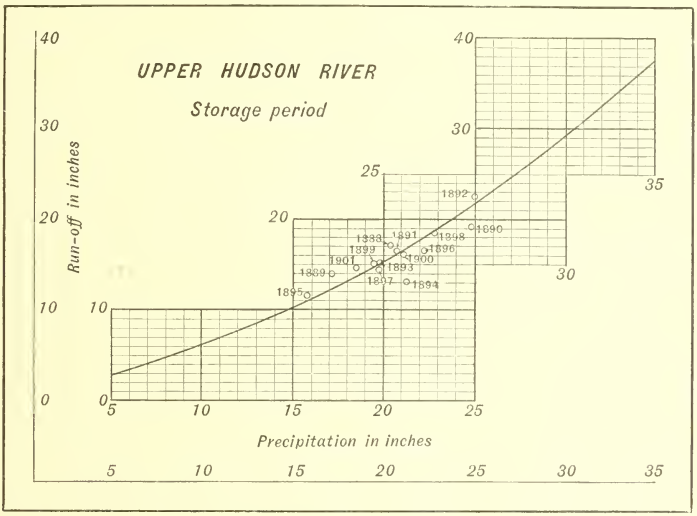


FIG. 16.—Run-off diagram of Croton River.

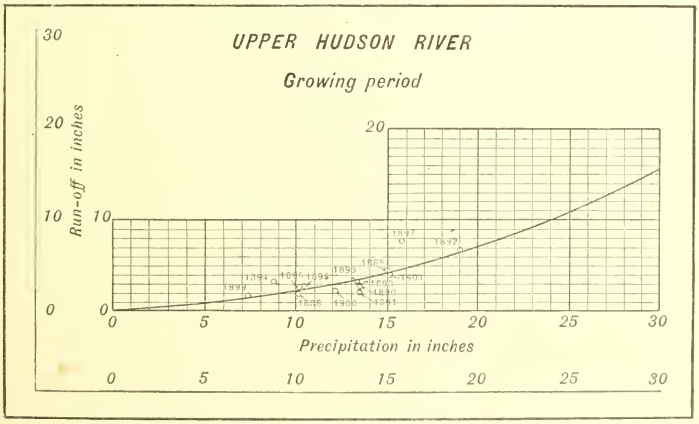
The maximum, minimum, and mean run-off may be obtained from he tabulations on each figure except for Passaic River.

It is evident that proceeding in the same way as for the foregoing liagrams, figs. 12–16, inclusive, diagrams may be prepared for the torage, growing, and replenishing periods, and a curve drawn from vhich the run-off for a given rainfall may be taken.



IG. 17.—Diagram showing the relation between precipitation and run-off in the Upper Hudson River Basin during the storage period.

Fig. 17 is such a diagram for the storage period on the Upper Hud- on River for the years 1888–1901, inclusive. This diagram shows hat aside from the years 1890 and 1894 the run-offs of this catchment rea were substantially accurate during the storage period. It is



IG. 18.—Diagram showing the relation between the precipitation and run-off in the Upper Hudson River Basin during the growing period.

robable that in these two years their accuracy may have been inter- ered with by ice, although just the cause is not definitely known— may have been in the rainfall.

Fig. 18 is a similar diagram for the Upper Hudson River during the

growing period for the same years. This diagram shows that aside from 1897, the run-offs were substantially right during this period.

Fig. 19 is a similar diagram for the Upper Hudson River during the replenishing period for the same years. This diagram shows that in

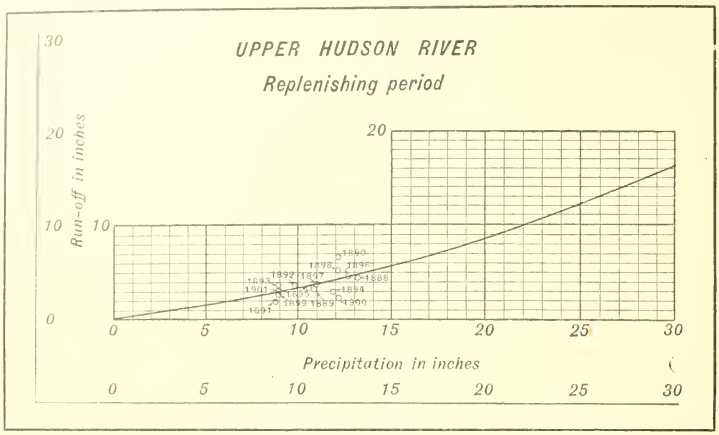


FIG. 19.—Diagram showing the precipitation and run-off in the Upper Hudson River Basin during the replenishing period.

1890 and 1900 there was a discrepancy, which, as in the previous cases, was presumably in the precipitation of that period.

Fig. 20 is a similar diagram for the storage period of Sudbury River. The observations in this case are so scattering that we may safely conclude that ice plays a very important part in the discord-

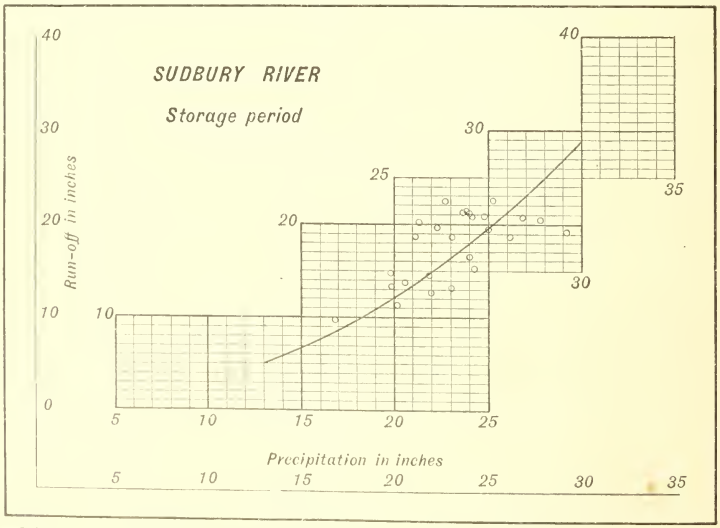


FIG. 20.—Diagram showing the relation between precipitation and run-off in the Sudbury River Basin during the storage period.

ancy of Sudbury River observations during the storage period. There is, however, during the earlier years, a lack of complete precipitation observations on the Sudbury catchment area, although it is not considered that this is a very important cause, for the reason that the

growing and replenishing periods on this stream show much better results than the storage period. The most probable assumption, therefore, seems to be the disturbing effect of ice in the storage period.

Fig. 21 is a similar diagram of Sudbury River for the growing period. With the exception of three years, the observations for this period are very reliable.

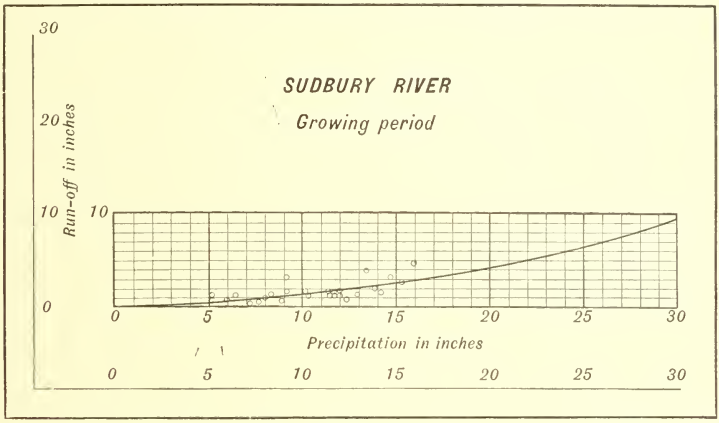


FIG. 21.—Diagram showing the relation between precipitation and run-off in the Sudbury River Basin during the growing period.

Fig. 22 is a similar diagram of Sudbury River for the replenishing period. In this case, the observations are all good except for one year.

Proceeding on similar lines, the writer prepared, several years ago,

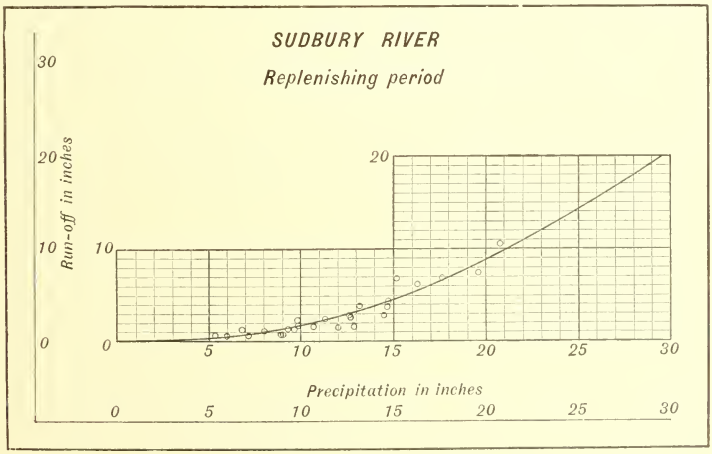


FIG. 22.—Diagram showing the relation between precipitation and run-off in the Sudbury River Basin during the replenishing period.

a series of curves, from which the monthly run-offs may be taken. But, unfortunately, owing to negative evaporation in the storage period, the individual months of that period were so discordant as to be very unsatisfactory. The writer, therefore, does not give any such

diagrams in this connection. His present view is that, for the reason stated, they can not be safely used.

Fig. 23 is a section of Mechanicville dam, over which the gagings of Hudson River have been made.

One or two general conclusions of some interest may be drawn from figs. 12–16, inclusive. For instance, taking the extreme low water as represented by the year 1895, on Muskingum River, at 4.9 inches for the whole year, with a rainfall of 29.8 inches, it is interesting to observe that in the preceding year of 1894, there was a total run-off of 8.7 inches, with a total rainfall of 30.5 inches. That is to say, the rainfall for the year 1894 was 0.7 inch greater than in 1895, but the run-off was 3.8 inches greater. This extreme difference may be ascribed to the difference in the height of ground water. In 1895, ground water stood much lower than in 1893, with the result of a lower run-off.

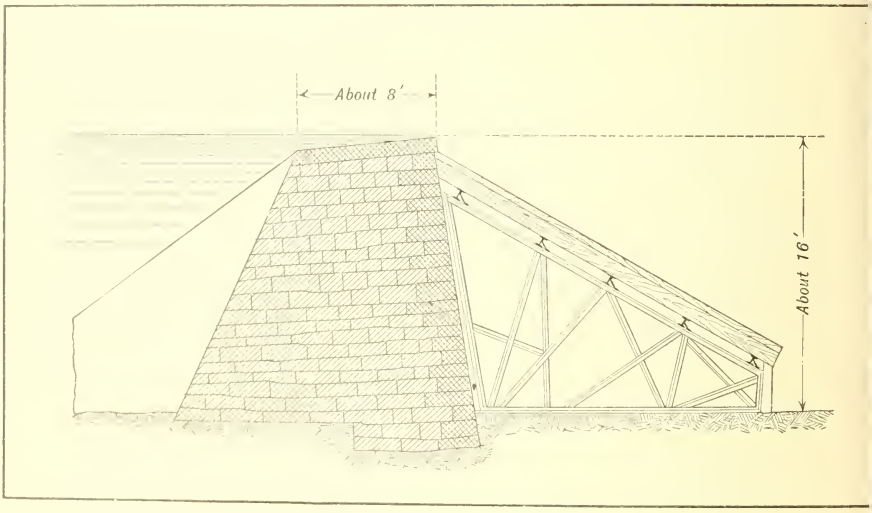


FIG. 23.—Section of Mechanicville dam.

On fig. 12, with a precipitation of 30 inches, the run-off is found to be 6 inches, while on fig. 13, with a precipitation of 30 inches, run-off ordinarily may be expected to be about 8 inches. This statement is made on the assumption that the curve is drawn in a mean position, or in such a way as to give average mean results, but it should not be overlooked that Muskingum River observations are too few to draw absolute conclusions. The diagram, fig. 13, shows that there is some lack of accuracy in at least one-half of them.

Fig. 12 shows that on Hudson River, if during any year the total rainfall should sink to 30 inches, the run-off may be expected to be somewhat less than 10 inches, though the modifying effect of full or low ground water may be taken into account in reaching such conclusion. Probably there would be, due to elevation of ground water, a variation of perhaps 2 inches.

On the diagram of Passaic River, fig. 14, 30 inches of precipitation indicates 14 inches of run-off. This is very high, and shows that further study of the Passaic is needed before one can safely accept the results as entirely reliable.

On the diagram of Sudbury River, fig. 15, a precipitation of 30 inches may be expected to produce a run-off of about 7 inches, showing that this stream is, as regards run-off characteristics, very closely allied to Genesee and Muskingum rivers.

On the diagram of Croton River, fig. 16, it is also seen that 30 inches precipitation may be expected to produce a little less than 7 inches of run-off, showing also that this stream has substantially the characteristics of Genesee River.

In all of the foregoing statements as to minimum run-off, it should be understood that the actual quantity appearing in the stream as run-off from a given precipitation will vary, depending on whether ground water is high or low at the beginning of the period considered. All such statements, therefore, are necessarily approximate—they may have a plus or minus variation from the diagram of one or two inches.

SUMMARY.

In order to assist the discussion, the following summary, which includes, it is believed, the more important points of the paper, is herewith submitted:

1. There is no general expression giving accurately the relation of rainfall to run-off. The run-off of a stream is influenced by so many complex elements that the data are lacking for final conclusions. Every stream is, in effect, a law unto itself. An empirical formula may, however, be made, which will give for some streams approximately the run-off for a series of years.

2. The cause of rainfall is not very well understood, although there is one principle upon which there is no disagreement—that in order to produce rain, the temperature of the air must be cooled below the dew point.

3. The errors in rainfall measurements are so large that one may safely state that nearly all measurements are merely approximations.

4. In view of the foregoing proposition, to carry rainfall measurements out to more than one decimal place is an unnecessary refinement.

5. As a general statement the minimum rainfall may be placed at from one-half to one-fourth of the maximum.

6. It is uncertain whether rainfall is in any degree increasing.

7. In England there is sometimes an increase of rainfall with increase of elevation,[a] but in the United States the areas are so large

[a] See remarks of H. Somerby Wallis on this point in Monthly Weather Review for April, 1902, p. 228.

that as soon as one goes away from the influence of the ocean very frequently this peculiarity does not appear. In a very large number of cases the reverse is true.

8. Contours can not be satisfactorily drawn on a rainfall map of the State of New York until we have a larger number of stations and longer periods of observation.

9. Rainfall and run-off records are conveniently divided into storage, growing, and replenishing periods, such division facilitating computations and bringing out the salient points. A large percentage of the total water supply runs off during the storage period.

10. Assuming that a rainfall record is accurate, it should cover about thirty-five years before it can be relied upon within 2 per cent. As to a run-off record, the number of long records are as yet too few to furnish satisfactory answers to questions concerning run-off.

11. The best unit of measurement is cubic feet per second, and the next best is inches on the catchment area.

12. The run-off of streams has been generally overestimated. The minimum flow may be as low as from 0.05 to 0.1 of a cubic foot per square mile per second. Streams issuing from sand plains may show from 0.5 to 0.6 of a cubic foot per square mile per second. Generally speaking, the range will not be outside of from 0.05 to 0.5 of a cubic foot per square mile per second.

13. As regards run-off, streams may be divided into classes, in the first of which will fall streams with a maximum rainfall from 50 to 60 inches and with a maximum run-off somewhat more than one-half the rainfall, etc. They may be also classified with regard to evaporation, as will be noted further on.

14. The run-off of streams can not be satisfactorily estimated from diagrams of monthly rainfall.

15. The run-off of a stream is materially influenced by the number of lakes within its catchment area.

16. Generally speaking, maximum-discharge formulas are unsatisfactory guides and are hardly worth the trouble their use entails. Exceptions to this may be taken in the use of Dickens and Ryves's formulas.

17. Safe deductions can not be made from an average run-off. What is wanted is a clear statement of the minimum, together with the longest period which it may be expected to occupy.

18. There is very serious danger in using percentages.

19. The influence of the May rainfall is such that when above the normal, stream flow is likely to be well maintained during the summer.

20. As regards delivery of streams, what is wanted in a stream is as large a ground flow as possible, with small evaporation.

21. When rainfall is below the mean for several months, ground water may be expected to become continuously lower, with the result that the flow of streams will be less.

22. The run-off of streams will vary with the velocity of wind, pressure, force of vapor, etc.

23. For individual streams an exponential formula is undoubtedly the best. By its use the given data may be more closely represented than in any other manner.

24. Annual run-off diagrams may be taken as a criterion as to the accuracy with which the observations have been made.

25. When a run-off record is given, without the rainfall, the rainfall may be computed by assuming the evaporation and making a series of approximations.

26. The run-off of streams with very great difference in size of catchment areas may be experimentally compared.

27. The extreme low-water period may extend over at least two years and occasionally over three years.

28. In order to clarify the whole matter of stream gagings, what is wanted in the future is a brief, explicit statement of just how the stream was measured, thus enabling hydrologists to judge of the accuracy of the method.

29. There is considerable variation in weir measurements, due to form of weir alone. The formula for a sharp-crested weir can not be applied to any other form without large variation.

30. The several diagrams, as well as the evaporation formula, show that there is no relation between evaporation and mean annual temperature.

31. The laws of evaporation are exhibited in the chapter on "Evaporation relations," by Professor Tate.

32. Evaporation is a persistently uniform element. The tendency is to remain at about the same figure from year to year.

33. In addition to the classification of streams with reference to rainfall, those with large evaporations may be placed in a class by themselves.

34. Streams with large evaporation are, so far as known, always deforested.

35. Negative evaporation exists on all the streams included in the tables. When negative evaporation exceeds more than two consecutive months there is, generally speaking, some doubt about the accuracy of the record.

36. The ground water must be taken into account in order to understand all the peculiarities of flow. A very important effect of forests is in increasing the ground-water flow.

37. It is uncertain whether difference in geology has much influence on run-off, although it appears that porous, sandy soils do considerably affect the result. There are, however, a number of cases which indicate that it may have important influence, although an examination of the evidence shows that the theory that forests materially influence

the run-off is more reasonable than that percolation through geologic formations exercises much influence.

38. So far as present information goes there is little or no relation between topography and the run-off of streams. Deforestation appears to exercise a much more important influence.

39. It is uncertain whether forests in any way influence the quantity of rainfall.

40. The extent of forestation seems to have considerable effect on the run-off of streams, catchments with dense forests showing larger run-off for the same rainfall than those which are deforested. As a tentative proposition it may be said that the removal of forests notably decreases stream flow.

41. The effect of forests is clearly shown on Hudson River.

42. Catchment areas from which municipal water supplies are drawn should be heavily forested. This is a broad proposition merely.

43. If the Croton catchment area had growing upon it a forest from one hundred to one hundred and fifty years old there would probably be, on an average, about 5 inches more annual run-off then there is under present conditions. Nevertheless it would not be a good investment for the city of New York to reforest this area, for the reason that the gain in water supply would not be commensurate with the expense.

The foregoing summary indicates a large number of factors which in some degree affect the run-off of streams. Moreover, only the main factors have been noted; there are many more of less importance.

There is a large amount of useful information on the general subject of the relation of forests to rainfall in Bulletin No. 7 of the Forestry Division of United States Department of Agriculture—Forest Influences—which, since that bulletin is readily obtained, has not been specially referred to here.

Finally, this paper is an attempt to establish a more rational theory of the relation between rainfall and run-off of streams than has thus far obtained.

TABLES.

TABLE NO. 1.—*Muskingum River, 1888–1895, inclusive.*

[Catchment area—5,828 square miles.]

Period.	1888.			1889.			1890.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	17.16	5.17	11.99	13.52	6.02	7.50	27.77	18.07	9.70
Growing	14.31	1.77	12.54	12.12	1.24	10.88	13.68	2.64	11.04
Replenishing	11.14	3.39	7.75	10.24	.96	9.28	15.52	6.13	9.39
Year	42.61	10.33	32.28	35.88	8.22	27.66	56.97	26.84	30.13
	1891.			1892.			1893.		
Storage	16.72	12.42	4.30	20.39	9.06	11.33	25.04	14.13	10.91
Growing	13.56	1.77	11.79	16.54	3.65	12.89	8.31	1.22	7.09
Replenishing	7.08	1.37	5.71	4.81	.67	4.14	9.01	.85	8.16
Year	37.36	15.56	21.80	41.74	13.38	28.36	42.36	16.20	26.16
				1894.			1895.		
Storage				16.93	7.63	9.30	13.04	4.04	9.00
Growing				4.56	.66	3.90	9.14	.49	8.65
Replenishing				9.02	.41	8.61	7.66	.37	7.29
Year				30.51	8.70	21.81	29.84	4.90	24.94

TABLE NO. 2.—*Genesee River, 1890–1898, inclusive.*

[Catchment area—1,070 square miles.]

Period.	1890.			1891.			1892.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	[a] 23.01	[b] 12.96	[b] 10.05	18.22	11.88	6.34	19.84	9.38	10.46
Growing	[a] 10.52	2.51	8.01	12.78	1.06	11.72	15.30	4.90	10.40
Replenishing	[a] 14.01	5.75	8.26	7.12	1.11	6.01	6.55	1.14	5.41
Year	[a] 47.54	[b] 21.22	[a] 26.32	38.12	14.05	24.07	41.69	15.42	26.27
	1893.			1894.			1895.		
Storage	20.65	[b] 11.10	[b] 9.55	27.71	15.73	11.98	13.20	5.63	7.57
Growing	9.55	[b] 1.00	[b] 8.55	7.95	1.46	6.49	11.13	.36	10.77
Replenishing	9.10	1.25	7.85	12.13	2.19	9.94	6.67	.68	5.99
Year	39.30	[b] 13.35	[b] 25.95	47.79	19.38	28.41	31.00	6.67	24.33
	1896.			1897.			1898.		
Storage	17.84	9.25	8.59	15.68	7.31	8.37	18.66	10.40	8.26
Growing	10.28	.83	9.45	11.92	1.34	10.58	14.15	2.05	12.10
Replenishing	12.56	2.72	9.84	6.79	.73	6.06	9.69	2.68	7.01
Year	40.68	12.80	27.88	34.39	9.38	25.01	42.50	15.13	27.37

[a] For years 1890–1892 the run-off is that of Oatka Creek, a tributary of Genesee River, and the rainfall of Oatka Creek catchment area has been taken rather than that of entire upper Genesee area.

[b] Approximate.

TABLE No. 3. *Croton River, 1868–1899, inclusive.*

[Catchment area—338.8 square miles.]

Period.	1868. Rainfall.	1868. Run-off.	1868. Evaporation.	1869. Rainfall.	1869. Run-off.	1869. Evaporation.	1870. Rainfall.	1870. Run-off.	1870. Evaporation.
Storage	23.24	17.25	5.99	21.89	15.75	6.14	28.42	19.01	9.41
Growing	13.64	5.75	7.89	7.77	2.01	5.76	10.59	1.56	9.03
Replenishing	14.85	11.06	3.79	15.09	4.39	10.70	10.09	.96	9.13
Year	51.73	34.06	17.67	44.75	22.15	22.60	49.10	21.53	27.57

Period.	1871. Rainfall.	1871. Run-off.	1871. Evaporation.	1872. Rainfall.	1872. Run-off.	1872. Evaporation.	1873. Rainfall.	1873. Run-off.	1873. Evaporation.
Storage	19.83	9.72	10.11	14.57	10.31	4.26	22.19	18.52	3.67
Growing	16.04	2.61	13.43	14.33	3.01	11.32	8.65	1.54	7.11
Replenishing	11.95	5.65	6.30	10.75	4.38	6.37	12.58	3.20	9.38
Year	47.82	17.98	29.84	39.65	17.70	21.95	43.42	23.26	20.16

Period.	1874. Rainfall.	1874. Run-off.	1874. Evaporation.	1875. Rainfall.	1875. Run-off.	1875. Evaporation.	1876. Rainfall.	1876. Run-off.	1876. Evaporation.
Storage	23.74	22.86	0.88	17.10	14.81	2.29	22.64	19.89	2.75
Growing	12.30	2.77	9.53	16.45	5.86	10.59	7.14	1.07	6.07
Replenishing	8.68	1.60	7.08	10.33	3.41	6.92	10.11	1.35	8.76
Year	44.72	27.23	17.49	43.88	24.08	19.80	39.89	22.31	17.58

Period.	1877. Rainfall.	1877. Run-off.	1877. Evaporation.	1878. Rainfall.	1878. Run-off.	1878. Evaporation.	1879. Rainfall.	1879. Run-off.	1879. Evaporation.
Storage	17.49	12.36	5.13	20.99	14.19	6.80	25.17	20.81	4.36
Growing	13.17	.96	12.21	11.29	2.57	8.72	18.09	2.63	15.46
Replenishing	18.46	5.49	12.97	16.72	5.01	11.71	6.96	1.88	5.08
Year	49.12	18.81	30.31	49.00	21.77	27.22	50.22	25.32	24.90

Period.	1880. Rainfall.	1880. Run-off.	1880. Evaporation.	1881. Rainfall.	1881. Run-off.	1881. Evaporation.	1882. Rainfall.	1882. Run-off.	1882. Evaporation.
Storage	19.78	12.19	7.59	24.53	14.79	9.74	27.91	16.85	11.06
Growing	11.42	.68	10.74	9.61	1.95	7.66	9.03	2.06	6.97
Replenishing	7.57	.84	6.73	8.96	.97	7.99	19.10	6.21	12.89
Year	38.77	13.71	25.06	43.10	17.71	25.39	56.04	25.12	30.92

Period.	1883. Rainfall.	1883. Run-off.	1883. Evaporation.	1884. Rainfall.	1884. Run-off.	1884. Evaporation.	1885. Rainfall.	1885. Run-off.	1885. Evaporation.
Storage	19.03	11.37	7.66	24.81	16.85	7.96	21.86	15.36	6.50
Growing	12.10	1.09	11.01	15.72	2.34	13.38	12.89	.88	12.01
Replenishing	10.41	1.28	9.13	8.01	1.87	6.14	12.23	2.92	9.31
Year	41.54	13.74	27.80	48.54	21.06	27.48	46.98	19.16	27.82

Period.	1886. Rainfall.	1886. Run-off.	1886. Evaporation.	1887 Rainfall.	1887 Run-off.	1887 Evaporation.	1888. Rainfall.	1888. Run-off.	1888. Evaporation.
Storage	25.45	18.16	7.29	23.05	16.44	6.61	30.33	21.74	8.59
Growing	11.68	1.53	10.15	24.75	6.71	18.04	11.25	2.63	8.62
Replenishing	9.82	1.23	8.59	7.78	2.60	5.18	18.76	8.23	10.53
Year	46.95	20.92	26.03	55.58	25.75	29.83	60.34	32.60	27.74

TABLE No. 3.—*Croton River, 1868–1899, inclusive*—Continued.

Period.	1889.			1890.			1891.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	22.40	16.86	5.54	25.31	19.10	6.21	26.66	21.22	5.44
Growing	17.37	6.49	10.88	13.31	2.51	10.80	11.26	1.14	10.12
Replenishing	18.83	8.70	10.13	14.60	7.02	7.58	7.78	1.11	6.67
Year	58.60	32.05	26.55	53.22	28.63	24.59	45.70	23.47	22.23
	1892.			1893.			1894.		
Storage	22.93	12.87	10.06	27.34	21.41	5.93	23.24	15.65	7.59
Growing	15.37	2.60	12.77	12.39	1.84	10.55	7.95	1.82	6.13
Replenishing	10.30	2.31	7.99	11.08	3.51	7.57	17.05	4.41	12.64
Year	48.60	17.78	30.82	50.81	26.76	24.05	48.24	21.88	26.36
	1895.			1896.			1897.		
Storage	19.55	14.78	4.77	24.84	18.01	6.83	20.55	14.64	5.91
Growing	11.19	1.05	10.14	12.25	2.03	10.22	20.79	6.93	13.86
Replenishing	9.54	1.27	8.27	11.27	3.13	8.14	8.76	2.73	6.03
Year	40.28	17.10	23.18	48.36	23.17	25.19	50.10	24.30	25.80
					1898.			1899.	
Storage				28.81	20.08	8.73	22.66	21.38	1.28
Growing				17.17	4.83	12.34	12.19	1.57	10.62
Replenishing				13.36	3.99	9.37	10.37	1.96	8.41
Year				59.34	28.90	30.44	45.22	24.91	20.31
				Mean 1868–1876, inclusive.			Mean 1877–1899, inclusive.		
Storage				21.51	16.46	5.05	23.68	16.83	6.85
Growing				11.88	2.91	8.97	13.58	2.57	11.01
Replenishing				11.61	4.00	7.61	12.08	3.42	8.66
Year				45.00	23.37	21.63	49.33	22.81	26.52

TABLE No. 4.—*Lake Cochituate, 1863–1900, inclusive.*

Catchment area 18.9 square miles, not including catchment of Dudley Pond.

Period.	1863.			1864.			1865.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	29.49	16.31	13.18	24.70	14.44	10.26	29.63	17.28	12.35
Growing	21.71	5.15	16.56	5.20	1.58	3.62	7.37	1.27	6.10
Replenishing	16.49	5.25	11.24	13.47	3.17	10.30	13.43	2.15	11.28
Year	67.69	26.71	40.98	43.37	19.19	24.18	50.43	20.70	29.73
	1866.			1867.			1868.		
Storage	22.87	9.38	13.49	27.02	16.47	10.55	23.02	16.95	6.07
Growing	22.13	2.94	19.19	20.67	3.34	17.33	12.49	3.22	9.27
Replenishing	16.31	3.26	13.05	10.98	2.43	8.55	15.65	4.76	10.89
Year	61.31	15.58	45.73	58.67	22.44	36.43	51.16	24.93	26.23
	1869.			1870.			1871.		
Storage	28.91	12.83	16.08	36.50	23.72	12.78	19.77	10.19	9.58
Growing	8.65	2.39	6.26	9.18	1.91	7.27	11.72	2.15	9.57
Replenishing	21.25	4.77	16.48	13.00	2.85	10.15	13.85	2.38	11.47
Year	58.81	19.99	38.82	58.68	28.48	30.20	45.34	14.72	30.62
	1872.			1873.			1874.		
Storage	14.51	8.88	5.63	20.00	18.51	1.49	20.76	16.23	4.53
Growing	19.58	2.95	16.63	11.63	2.47	9.16	12.78	3.83	8.95
Replenishing	14.20	5.39	8.81	13.27	4.68	8.59	4.64	1.63	3.01
Year	48.29	17.22	31.07	44.90	25.66	19.24	38.18	21.69	16.49
	1875.			1876.			1877.		
Storage	17.80	10.76	7.04	20.45	14.91	5.54	21.61	15.65	5.96
Growing	15.34	2.35	12.99	13.28	1.64	11.64	8.76	2.24	6.52
Replenishing	13.11	3.75	9.36	12.57	3.22	9.35	15.54	4.31	11.23
Year	46.25	16.86	29.39	46.30	19.77	26.53	45.91	22.20	23.71
	1878.			1879.			1880.		
Storage	23.38	19.08	4.30	19.96	16.83	3.13	18.47	8.55	9.92
Growing	13.74	2.07	11.67	13.95	2.05	11.90	12.06	.62	11.44
Replenishing	12.36	3.09	9.27	5.62	1.93	3.69	6.34	1.56	4.78
Year	49.48	24.24	25.24	39.53	20.81	18.72	36.87	10.73	26.14
	1881.			1882.			1883.		
Storage	22.23	12.74	9.49	23.10	12.39	10.71	16.62	8.31	8.31
Growing	8.74	1.56	7.18	6.50	.75	5.75	5.08	.16	4.92
Replenishing	8.85	1.25	7.60	12.35	2.39	9.96	8.53	1.62	6.91
Year	39.82	15.55	24.27	41.95	15.53	26.42	30.23	10.09	20.14

TABLE No. 4.—*Lake Cochituate, 1863–1900, inclusive*—Continued.

Period.	1884.			1885.			1886.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	24.79	15.70	9.09	22.80	11.90	10.90	24.14	18.97	5.17
Growing	12.79	1.54	11.25	11.70	.76	10.94	8.26	.57	7.69
Replenishing	5.82	1.09	4.73	12.15	3.09	9.06	11.12	1.92	9.20
Year	43.40	18.33	25.07	46.65	15.75	30.90	43.52	21.46	22.06
	1887.			1888.			1889.		
Storage	26.97	19.91	7.06	24.22	15.44	8.78	21.79	17.26	4.53
Growing	10.05	2.87	7.18	10.06	1.94	8.12	16.84	6.24	10.60
Replenishing	6.53	1.83	4.70	20.79	9.09	11.70	14.56	6.65	7.91
Year	43.55	24.61	18.94	55.07	26.47	28.60	53.19	30.15	23.04
	1890.			1891.			1892.		
Storage	23.42	17.17	6.25	27.73	28.21	−0.48	21.11	12.47	8.64
Growing	7.43	2.20	5.23	11.68	1.99	9.69	10.49	1.38	9.11
Replenishing	17.82	6.29	11.53	9.10	2.38	6.72	9.43	2.26	7.17
Year	48.67	25.66	23.01	48.51	32.58	15.93	41.03	16.11	24.92
	1893.			1894.			1895.		
Storage	22.84	12.40	10.44	21.00	10.25	10.75	20.18	11.29	8.89
Growing	11.01	1.90	9.11	7.79	1.24	6.55	11.79	1.45	10.34
Replenishing	7.58	2.51	5.07	10.94	2.04	8.90	18.66	6.17	12.49
Year	41.43	16.81	24.62	39.73	13.53	26.20	50.63	18.91	31.72
	1896.			1897.			1898.		
Storage	20.91	15.96	4.95	19.87	11.05	8.82	26.61	16.15	10.46
Growing	7.69	1.55	6.14	12.34	2.57	9.77	12.71	2.45	10.26
Replenishing	14.74	3.70	11.04	9.92	2.58	7.34	16.76	4.26	12.50
Year	43.34	21.21	22.13	42.13	16.20	25.93	56.08	22.86	33.22
				1899.			1900.		
Storage				22.31	18.38	3.93	28.30	14.09	14.21
Growing				8.16	.23	7.93	9.25	1.49	7.76
Replenishing				10.01	1.63	8.38	13.01	2.72	10.29
Year				40.48	20.24	20.24	50.56	18.30	32.26
				Mean for 5 years, 1896–1900, inclusive.			Mean for 38 years, 1863–1900, inclusive.		
Storage				23.60	15.13	8.47	23.15	14.92	8.23
Growing				10.03	1.66	8.37	11.59	2.08	9.51
Replenishing				12.89	2.98	9.91	12.38	3.32	9.06
Year				46.52	19.77	26.75	47.13	20.32	26.81

TABLE No. 5.—*Sudbury River, 1875–1900, inclusive.*

[Catchment area, 1875–1878, inclusive, 77.76 square miles; 1879–80, 78.24 square miles; 1881–1899, 75.2 square miles.]

Period	1875. Rainfall	1875. Run-off.	1875. Evaporation.	1876. Rainfall.	1876. Run-off.	1876. Evaporation.	1877. Rainfall.	1877. Run-off.	1877. Evaporation.
Storage	19.78	14.69	5.09	21.37	20.10	1.27	23.07	18.71	4.36
Growing	15.34	2.78	12.56	12.89	1.43	11.46	9.06	1.61	7.45
Replenishing	13.11	3.76	9.35	12.62	2.61	10.01	14.64	3.68	10.96
Year	48.23	21.23	27.00	46.88	24.14	22.74	46.77	24.00	22.77

Period	1878. Rainfall	1878. Run-off.	1878. Evaporation.	1879. Rainfall.	1879. Run-off.	1879. Evaporation.	1880. Rainfall.	1880. Run-off.	1880. Evaporation.
Storage	23.91	21.05	2.86	23.84	21.19	2.65	20.15	11.19	8.96
Growing	13.79	1.95	11.84	14.23	1.70	12.53	12.42	.83	11.59
Replenishing	14.73	4.12	10.61	5.37	.72	4.65	7.13	.67	6.46
Year	52.43	27.12	25.31	43.44	23.61	19.83	39.70	12.69	27.01

Period	1881. Rainfall	1881. Run-off.	1881. Evaporation.	1882. Rainfall.	1882. Run-off.	1882. Evaporation.	1883. Rainfall.	1883. Run-off.	1883. Evaporation.
Storage	24.27	15.07	9.20	23.99	16.33	7.66	16.78	9.70	7.08
Growing	9.10	3.07	6.03	5.10	1.17	3.93	5.81	.86	4.95
Replenishing	9.66	1.35	8.31	11.96	1.42	10.54	8.93	.84	8.09
Year	43.03	19.49	23.54	41.05	18.92	22.13	31.52	11.40	20.12

Period	1884. Rainfall	1884. Run-off.	1884. Evaporation.	1885. Rainfall.	1885. Run-off.	1885. Evaporation.	1886. Rainfall.	1886. Run-off.	1886. Evaporation.
Storage	27.78	20.38	7.40	21.90	14.36	7.54	24.19	20.75	3.44
Growing	11.76	1.58	10.18	11.47	1.27	10.20	8.83	.72	8.11
Replenishing	5.98	.53	5.45	12.61	2.84	9.77	10.78	1.62	9.16
Year	45.52	22.49	23.03	45.98	18.47	27.51	43.80	23.09	20.71

Period	1887. Rainfall	1887. Run-off.	1887. Evaporation.	1888. Rainfall.	1888. Run-off.	1888. Evaporation.	1889. Rainfall.	1889. Run-off.	1889. Evaporation.
Storage	25.28	22.43	2.85	24.98	19.53	5.45	21.14	18.71	2.43
Growing	11.69	1.30	10.39	10.16	1.61	8.55	15.91	4.81	11.10
Replenishing	6.93	1.17	5.66	20.80	10.32	10.48	15.15	6.97	8.18
Year	43.80	24.90	18.90	55.94	31.46	24.48	52.20	30.49	21.71

Period	1890. Rainfall	1890. Run-off.	1890. Evaporation.	1891. Rainfall.	1891. Run-off.	1891. Evaporation.	1892. Rainfall.	1892. Run-off.	1892. Evaporation.
Storage	24.77	20.87	3.90	29.96	25.90	4.06	23.15	13.12	10.03
Growing	8.36	1.41	6.95	11.89	1.27	10.62	11.43	1.62	9.81
Replenishing	17.71	6.94	10.77	9.30	1.25	8.05	9.81	1.82	7.99
Year	50.84	29.22	21.62	51.15	28.42	22.73	44.39	16.56	27.83

TABLE No. 5.—*Sudbury River, 1875–1900, inclusive*—Continued.

Period.	1893.			1894.			1895.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	26.13	18.72	7.41	21.94	12.57	9.37	20.52	13.77	6.75
Growing	10.36	1.26	9.10	6.44	1.38	5.06	11.96	1.12	10.84
Replenishing	7.99	1.13	6.86	11.41	2.37	9.04	19.61	7.41	12.20
Year	44.48	21.11	23.37	39.79	16.32	23.47	52.09	22.30	29.79

	1896.			1897.			1898.		
Storage	22.30	19.64	2.66	19.88	13.23	6.65	26.81	20.65	6.16
Growing	8.13	.96	7.17	13.41	3.88	9.53	14.74	3.29	11.45
Replenishing	14.50	2.87	11.63	9.81	2.06	7.75	16.26	6.14	10.12
Year	44.93	23.47	21.46	43.10	19.17	23.93	57.81	30.08	27.73

	1899.			1900.		
Storage	22.73	22.28	0.45	29.13	19.12	10.01
Growing	7.16	.09	7.07	7.67	.46	7.21
Replenishing	8.82	.90	7.92	12.89	1.58	11.31
Year	38.71	23.27	15.44	49.69	21.16	28.53

	Mean for 5 years, 1896–1900, inclusive.			Mean for whole period, 1875–1900, inclusive.		
Storage	24.17	18.98	5.19	23.45	17.85	5.60
Growing	10.22	1.74	8.48	10.74	1.67	9.06
Replenishing	12.46	2.71	9.75	11.86	2.96	8.90
Year	46.85	23.43	23.42	46.05	22.48	23.56

TABLE No. 6.—*Mystic Lake, 1878–1895, inclusive.*

[Catchment area—26.9 square miles.]

Period	1878.			1879.			1880.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	25.22	18.43	6.79	19.42	16.40	3.02	17.28	9.34	7.94
Growing	13.65	2.37	11.28	11.85	2.21	9.64	12.36	1.72	10.64
Replenishing	13.83	3.02	10.81	5.13	1.27	3.86	6.02	1.25	4.77
Year	52.70	23.82	28.88	36.40	19.88	16.52	35.66	12.31	23.35

	1881.			1882.			1883.		
Storage	23.16	14.02	9.14	22.69	12.47	10.22	16.24	7.41	8.83
Growing	10.11	3.27	6.84	5.49	1.38	4.11	5.29	1.04	4.25
Replenishing	7.85	1.10	6.75	12.03	1.50	10.53	8.93	.99	7.94
Year	41.12	18.39	22.73	40.21	15.35	24.86	30.46	9.44	21.02

	1884.			1885.			1886.		
Storage	24.21	16.57	7.64	21.35	11.03	10.32	24.47	20.82	3.65
Growing	13.21	2.03	11.18	12.35	1.87	10.48	8.49	1.21	7.28
Replenishing	5.40	.85	4.55	13.25	3.43	9.82	9.87	1.58	8.29
Year	42.82	19.45	23.37	46.95	16.33	30.62	42.83	23.61	19.22

	1887.			1888.			1889.		
Storage	25.83	17.44	8.39	24.03	16.09	7.94	23.17	17.47	5.70
Growing	14.24	3.49	10.75	10.66	1.77	8.89	15.69	5.27	10.42
Replenishing	7.59	1.76	5.83	20.37	9.09	11.28	13.94	4.76	9.18
Year	47.66	22.69	24.97	55.06	26.95	28.11	52.80	27.50	25.30

	1890.			1891.			1892.		
Storage	24.35	18.66	5.69	27.67	26.79	0.88	21.35	11.58	9.77
Growing	9.28	2.81	6.47	11.49	1.87	9.62	11.55	2.32	9.23
Replenishing	13.92	5.14	8.78	9.50	1.56	7.94	8.47	2.08	6.39
Year	47.55	26.61	20.94	48.66	30.22	18.44	41.37	15.98	25.39

	1893.			1894.			1895.		
Storage	23.09	15.42	7.67	21.34	11.14	10.20	18.50	10.34	8.16
Growing	9.55	2.20	7.35	6.69	1.78	4.91	13.41	1.82	11.59
Replenishing	8.36	1.67	6.69	11.59	1.85	9.74	18.50	4.09	14.41
Year	41.00	19.29	27.71	39.62	14.77	24.85	50.41	16.25	34.16

TABLE NO. 7.—*Neshaminy Creek, 1884–1899, inclusive.*

[Catchment area=139.3 square miles.]

Period.	1884.			1885.			1886.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	25.77	25.61	0.16	20.13	17.85	2.28	26.61	21.45	5.16
Growing	13.71	1.85	11.86	10.25	1.08	9.17	12.67	1.87	10.80
Replenishing	7.05	.45	6.60	11.22	1.73	9.49	7.60	.66	6.94
Year	46.53	27.91	18.62	41.60	20.66	20.94	46.88	23.98	22.90
	1887.			1888.			1889.		
Storage	21.88	15.92	5.96	26.48	21.17	5.31	22.32	13.44	8.88
Growing	19.26	4.44	14.82	11.83	1.01	10.82	22.42	10.00	12.42
Replenishing	7.59	1.03	6.56	14.18	6.02	8.16	22.18	12.37	9.81
Year	48.73	21.39	27.34	52.49	28.20	24.29	66.92	35.81	31.11
	1890.			1891.			1892.		
Storage	22.06	14.85	7.21	23.48	17.74	5.74	22.55	15.01	7.54
Growing	14.28	2.15	12.13	15.90	2.53	13.37	11.58	1.31	10.27
Replenishing	10.23	3.33	6.90	8.03	2.38	5.70	10.13	1.94	8.19
Year	46.57	20.33	26.24	47.46	22.65	24.81	44.26	18.26	26.00
	1893.			1894.			1895.		
Storage	22.16	18.52	3.64	26.68	18.16	8.52	20.97	15.84	5.13
Growing	12.21	1.70	10.51	8.95	1.82	7.13	11.41	2.07	9.34
Replenishing	11.07	3.74	7.33	16.45	6.12	10.33	6.21	.24	5.97
Year	45.44	23.96	21.48	52.08	26.10	25.98	38.59	18.15	20.44
				1896.			1897.		
Storage				20.52	11.54	8.98	19.28	10.60	8.68
Growing				10.80	1.65	9.15	17.70	6.50	11.20
Replenishing				12.65	3.41	9.24	9.06	2.11	6.95
Year				43.97	16.60	27.37	46.04	19.21	26.83
				1898.			1899.		
Storage				25.68	16.87	8.81	23.09	20.50	2.59
Growing				12.34	1.69	10.65	9.41	1.76	7.65
Replenishing				12.80	3.33	9.47	10.91	1.96	8.95
Year				50.82	21.89	28.93	43.41	24.22	19.19

TABLE NO. 8.—*Perkiomen Creek, 1884–1899, inclusive.*

[Catchment area=152 square miles.]

Period.	1884. Rainfall.	1884. Run-off.	1884. Evaporation.	1885. Rainfall.	1885. Run-off.	1885. Evaporation.	1886. Rainfall.	1886. Run-off.	1886. Evaporation.
Storage	25.25	25.19	0.06	20.47	15.29	5.18	26.03	19.74	6.29
Growing	15.53	4.07	11.46	9.83	1.68	8.15	11.76	3.35	8.41
Replenishing	7.54	1.59	5.95	9.49	2.38	7.11	9.00	2.02	6.98
Year	48.32	30.85	17.47	39.79	19.35	20.44	46.79	25.11	21.68
	1887.			1888.			1889.		
Storage	21.63	14.66	6.97	27.48	19.67	7.81	22.99	14.28	8.71
Growing	17.25	4.26	13.00	12.42	2.17	10.25	23.38	10.02	13.36
Replenishing	6.70	1.45	5.25	14.18	7.40	6.78	20.45	11.81	8.64
Year	45.59	20.37	25.22	54.08	29.24	24.84	66.82	36.11	30.71
	1890.			1891.			1892.		
Storage	24.68	18.15	6.53	22.89	17.35	5.54	23.64	15.89	7.75
Growing	14.35	3.11	11.24	18.32	3.25	15.07	11.06	2.38	8.68
Replenishing	10.31	4.52	5.79	8.15	2.69	5.46	9.33	2.66	6.67
Year	49.34	25.78	23.56	49.36	23.29	26.07	44.03	20.93	23.10
	1893.			1894.			1895.		
Storage	22.16	17.21	4.95	24.37	15.77	8.60	23.22	15.51	7.71
Growing	12.20	1.82	10.38	8.77	2.05	6.72	10.88	1.32	9.56
Replenishing	10.18	3.33	6.85	15.40	5.18	10.22	6.25	.75	5.50
Year	44.54	22.36	22.18	48.54	23.00	25.54	40.35	17.58	22.77
				1896.			1897.		
Storage				19.99	10.26	9.73	20.00	12.37	7.63
Growing				15.05	2.83	12.22	13.69	3.08	10.61
Replenishing				14.62	4.19	10.43	10.07	2.26	7.81
Year				49.66	17.28	32.38	43.76	17.71	26.05
				1898.			1899.		
Storage				24.24	15.74	8.50	22.79	20.49	2.30
Growing				9.98	1.39	8.59	14.12	2.46	11.66
Replenishing				13.85	3.90	9.95	11.36	4.01	7.35
Year				48.07	21.03	27.04	48.27	26.96	21.31

TABLE NO. 9.—*Tohickon Creek, 1884–1898, inclusive.*

[Catchment area=102.2 square miles.]

Period.	1884.			1885.			1886.		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	26.06	27.27	−1.21	21.86	19.45	2.41	28.54	27.79	0.75
Growing	17.52	6.53	10.99	11.31	1.54	9.77	11.10	2.27	8.83
Replenishing	7.97	1.35	6.62	10	2.94	7.06	9.05	2.04	7.01
Year	51.55	35.15	16.40	43.17	23.93	19.24	48.69	32.10	16.59
	1887.			1888.			1889.		
Storage	21.60	18.44	3.16	28.52	27.37	1.15	25.13	17.82	7.31
Growing	19.19	4.80	14.39	12.96	1.99	10.97	23.90	12.45	11.45
Replenishing	6.71	.91	5.80	16.04	10.14	5.90	21.34	13.70	7.64
Year	47.50	24.15	23.35	57.52	39.50	18.02	70.37	43.97	26.40
	1890.			1891.			1892.		
Storage	25.09	19.01	6.08	23.07	20.23	2.84	23.43	19.76	3.67
Growing	15.49	2.54	12.95	19.77	4.99	14.78	11.22	1.52	9.70
Replenishing	10.20	5.45	4.75	7.16	2.03	5.13	10.65	3.47	7.18
Year	50.78	27	23.78	50	27.25	22.75	45.30	24.75	20.55
	1893.			1894.			1895.		
Storage	22.82	22.05	0.77	27.04	21.65	5.39	21.35	19.91	1.44
Growing	14.82	2.10	12.72	6.95	.84	6.11	12.45	1.46	10.99
Replenishing	11.31	4.06	7.25	17.63	8.11	9.52	6.63	.28	6.35
Year	48.95	28.21	20.74	51.62	30.60	21.02	40.43	21.65	18.78
	1896.			1897.			1898.		
Storage	21.69	12.30	9.39	20.82	13.93	6.89	26.40	21.20	5.20
Growing	13.76	2.91	10.85	17.32	5.12	12.20	10.87	1	9.87
Replenishing	12.58	4.52	8.06	8.78	1.98	6.80	13.80	5.19	8.61
Year	48.03	19.73	28.30	46.92	21.03	25.89	51.07	27.39	23.68

TABLE NO. 10.—*Hudson River, 1888–1901, inclusive.*

Catchment area 4,500 square miles.]

Period.	1888. Rainfall.	1888. Run-off.	1888. Evaporation.	1889. Rainfall.	1889. Run-off.	1889. Evaporation.	1890. Rainfall.	1890. Run-off.	1890. Evaporation.
Storage	20.40	17.06	3.34	17.10	14.04	3.06	24.75	19.28	5.47
Growing	10.25	2.05	8.20	15.05	4.26	10.79	13.50	2.85	10.65
Replenishing	13.27	4.53	8.74	10.81	3.41	7.40	12.10	6.81	5.29
Year	43.92	[a]23.64	20.28	[a]42.96	21.71	21.25	[a]50.35	28.94	21.41

Period.	1891. Rainfall.	1891. Run-off.	1891. Evaporation.	1892. Rainfall.	1892. Run-off.	1892. Evaporation.	1893. Rainfall.	1893. Run-off.	1893. Evaporation.
Storage	20.69	16.59	4.10	24.95	22.50	2.45	19.83	15.20	4.63
Growing	13.49	2.07	11.42	19.12	6.87	12.25	13.37	3.12	10.25
Replenishing	8.78	1.90	6.88	9.80	3.71	6.09	8.98	3.59	5.39
Year	42.96	20.56	22.40	53.87	33.08	20.79	42.18	21.91	20.27

Period.	1894. Rainfall.	1894. Run-off.	1894. Evaporation.	1895. Rainfall.	1895. Run-off.	1895. Evaporation.	1896. Rainfall.	1896. Run-off.	1896. Evaporation.
Storage	21.37	13.18	8.19	15.79	11.68	4.11	22.17	16.52	5.65
Growing	8.73	3.20	5.53	10.37	2.36	8.01	10.25	2.53	7.72
Replenishing	11.87	2.99	8.88	10.51	3.42	7.09	12.79	4.58	8.21
Year	41.97	19.37	22.60	36.67	17.46	19.21	45.21	23.62	21.58

Period.	1897. Rainfall.	1897. Run-off.	1897. Evaporation.	1898. Rainfall.	1898. Run-off.	1898. Evaporation.	1899. Rainfall.	1899. Run-off.	1899. Evaporation.
Storage	19.77	14.60	5.17	22.80	18.61	4.19	19.48	15.15	4.33
Growing	15.80	7.79	8.01	13.52	3.24	10.28	7.40	1.63	5.77
Replenishing	10.94	3.80	7.14	12.19	5.27	6.92	8.91	2.76	6.15
Year	46.51	26.19	20.32	48.51	27.12	21.39	35.79	19.54	16.25

Period.	1900. Rainfall.	1900. Run-off.	1900. Evaporation.	1901. Rainfall.	1901. Run-off.	1901. Evaporation.
Storage	21.13	16.12	5.01	18.47	14.84	3.63
Growing	12.11	2.30	9.81	15.09	4.02	11.07
Replenishing	12.17	2.25	9.92	9.02	3	6.02
Year	45.41	20.67	24.74	42.58	21.86	20.72

[a] Approximate.

TABLE NO. 11.—*Pequannock River, 1891–1899, inclusive.*

[Catchment area=63.7 square miles.]

Period.	1891.			1892.			1893.		
	Rainfall.	Runoff.	Evaporation.	Rainfall.	Runoff.	Evaporation.	Rainfall.	Runoff.	Evaporation.
Storage	26.78	17.49	9.29	19.54	18.11	1.43	24.70	23.62	1.08
Growing	12.52	2.21	10.31	12.83	3.46	9.37	13.02	2.53	10.49
Replenishing	7.23	2.97	4.26	9.17	2.23	6.94	10.72	4.44	6.28
Year	46.53	22.67	23.86	41.54	23.80	17.74	48.44	30.59	17.85
	1894.			1895.			1896.		
Storage	20.29	18.59	1.70	19.69	18.08	1.61	25.62	19.29	6.33
Growing	5.81	2.20	3.61	10.07	1.66	8.41	13.51	3.47	10.04
Replenishing	16.33	8.33	8	8.16	1.37	6.79	14.52	7.18	7.34
Year	42.43	29.12	13.31	37.92	21.11	16.81	53.65	29.94	23.71
	1897.			1898.			1899.		
Storage	21.05	17.57	3.48	27.29	22.74	4.55	22.29	21.95	0.34
Growing	21.31	8.10	13.21	12.24	2.48	9.76	12.57	1.88	10.69
Replenishing	9.50	2.83	6.67	13.48	3.54	9.94	10.96	2.74	8.22
Year	51.86	28.50	23.36	53.01	28.76	24.25	45.82	26.57	19.25

TABLE No. 12.—*Connecticut River, 1872–1885, inclusive.*

(Catchment area, 10,234 square miles.)

Period.	1872.			1873.[a]			1874.[a]		
	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.	Rainfall.	Run-off.	Evaporation.
Storage	11.92	15.56	1.62	14.15	21.80	−3.64	23.03	23.04	0.04
Growing	8.96	6.20	19.67	19.11	2.71	7.49	44.37	6.62	7.75
Replenishing	12.42	6.64	5.78	15.04	5.22	9.82	7.76	2.15	5.61
Year	33.30	26.23	27.07	43.31	29.73	13.58	45.21	31.81	13.40

Period.	1875.			1876.[a]			1877.		
Storage	17.50	15.47	2.04	22.50	24.74	−2.24	18.09	12.68	5.41
Growing	14.55	3.80	10.75	12.51	3.35	9.16	14.00	2.91	11.09
Replenishing	11.37	3.60	7.76	10.57	2.28	8.29	13.08	5.27	7.81
Year	43.42	22.87	20.55	45.58	30.37	15.21	45.17	20.86	24.31

Period.	1878.			1879.			1880.		
Storage	21.88	18.02	3.86	23.19	21.49	1.70	18.29	14.78	3.51
Growing	13.59	3.45	10.14	16.07	2.92	13.15	11.82	2.45	9.37
Replenishing	10.56	3.06	7.50	9.48	2.93	6.55	11.58	2.62	8.96
Year	46.03	24.53	21.50	48.74	27.34	21.40	41.69	19.85	21.84

Period.	1881.			1882.			1883.		
Storage	20.83	16.02	4.81	[b]20.50	12.14	8.36	[b]12.85	8.73	4.12
Growing	11.30	2.93	8.37	[b]11.45	3.35	8.10	[b]13.50	2.51	10.99
Replenishing	11.38	3.39	7.99	[b]6.50	2.17	4.33	[b]6.20	1.37	4.83
Year	43.51	22.34	21.17	38.45	17.66	20.79	32.55	12.61	19.94

Period.	1884.			1885.		
Storage	21.42	20.20	1.22	18.58	13.63	4.95
Growing	12.14	2.79	9.35	14.82	3.20	11.62
Replenishing	8.51	2.61	5.90	11.76	5.61	6.15
Year	42.07	25.60	16.47	45.16	22.44	22.72

[a] Not included in means. [b] Rainfall computed, approximate.

TABLE NO. 13.—*Mean or average rainfall, run-off, and evaporation for storage, growing, and replenishing periods for 12 streams of the United States.*

Period.	Muskingum River, from 1888 to 1895, eight years. Catchment area, 5,828 square miles.			Genesee River, from 1890 to 1898, nine years. Catchment area, 1,070 square miles.			Croton River, from 1877 to 1899, twenty-three years. Catchment area, 338.8 square miles.		
	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.
Storage	18.8	9.6	9.2	19.4	10.5	8.9	23.7	16.8	6.9
Growing	11.6	1.7	9.9	11.5	1.7	9.8	13.6	2.6	11.0
Replenishing	9.3	1.8	7.5	9.4	2.0	7.4	12.1	3.4	8.7
Year	39.7	13.1	26.6	40.3	14.2	26.1	49.4	22.8	26.6

Period.	Lake Cochituate, from 1863 to 1900, thirty-eight years. Catchment area, 18.9 square miles.			Sudbury River, from 1875 to 1900, twenty-six years. Catchment area, 78.2 square miles.[a]			Mystic Lake, from 1878 to 1895, eighteen years. Catchment area, 26.9 square miles.		
	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.
Storage	23.1	14.9	8.2	23.5	17.9	5.6	22.4	15.1	7.3
Growing	11.6	2.1	9.5	10.7	1.7	9.0	10.9	2.3	8.6
Replenishing	12.4	3.3	9.1	11.9	3.0	8.9	10.8	2.6	8.2
Year	47.1	20.3	26.8	46.1	22.6	23.5	44.1	20.0	24.1

Period.	Neshaminy Creek, from 1884 to 1899, sixteen years. Catchment area, 139.3 square miles.			Perkiomen Creek, from 1884 to 1899, sixteen years. Catchment area, 152 square miles.			Tohickon Creek, from 1884 to 1898, fifteen years. Catchment area, 102.2 square miles.		
	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.
Storage	23.1	17.2	5.9	23.2	16.7	6.5	24.2	20.5	3.7
Growing	13.4	2.7	10.7	13.7	3.1	10.6	14.6	3.5	11.1
Replenishing	11.1	3.2	7.9	11.1	3.8	7.3	11.3	4.4	6.9
Year	47.6	23.1	24.5	48.0	23.6	24.4	50.1	28.4	21.7

Period.	Hudson River, from 1888 to 1901, fourteen years. Catchment area, 4,500 square miles.			Pequannock River, from 1891 to 1899, nine years. Catchment area, 63.7 square miles.			Connecticut River, from 1872 to 1885, eleven years.[b] Catchment area, 10,234 square miles.		
	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.	Rain.	Run-off.	Evaporation.
Storage	20.6	16.1	4.5	23.0	19.7	3.3	18.9	15.1	3.8
Growing	12.7	3.5	9.2	12.7	3.1	9.6	13.8	3.3	10.5
Replenishing	10.9	3.7	7.2	11.1	4.0	7.1	10.3	3.6	6.7
Year	44.2	23.3	20.9	46.8	26.8	20.0	43.0	22.0	21.0

[a] See explanatory matter.

[b] Three years omitted from mean.

TABLE No. 14.—*Low-water periods on Muskingum River.*

[Catchment area 5,828 square miles.]

First period				Second period.				Third period			
Months.	Gross depth, in inches.	Evaporation from water surface.	Net run-off, in inches.	Months.	Gross depth, in inches.	Evaporation from water surface.	Net run-off, in inches.	Months.	Gross depth, in inches.	Evaporation from water surface.	Net run-off, in inches.
1887.											
December	0.18	0.01	0.17								
1888.											
January	1.24	.01	1.23								
February	1.12	.01	1.11								
March	1.38	.01	1.37								
April	.80	.01	.79	1891.				1894.			
May	.45	.02	.43	May	0.45	0.02	0.43	April	0.75	0.01	0.74
June	.29	.02	.27	June	.91	.02	.89	May	.74	.02	.72
July	.81	.03	.78	July	.51	.03	.48	June	.42	.02	.40
August	.67	.03	.64	August	.35	.03	.32	July	.13	.03	.10
September	.61	.02	.59	September	.17	.03	.14	August	.11	.03	.08
October	.77	.02	.75	October	.26	.02	.24	September	.15	.03	.12
November	2.01	.01	2	November	.94	.01	.93	October	.10	.02	.08
December	.84	.01	.83	December	1.03	.01	1.02	November	.16	.01	.15
1889.				1892.				December	.36	.01	.35
January	1.89	.01	1.88	January	.74	.01	.73	1895.			
February	1.42	.01	1.41	February	2.40	.01	2.39	January	1.67	.01	1.66
March	.71	.01	.70	March	1.26	.01	1.25	February	.12	.01	.11
April	.88	.01	.87	April	1.38	.01	1.37	March	1.20	.01	1.19
May	.28	.02	.26	May	2.25	.02	2.23	April	.59	.01	.58
June	.47	.02	.45	June	2.30	.02	2.28	May	.10	.02	.08
July	.55	.03	.52	July	.75	.03	.72	June	.17	.02	.15
August	.22	.03	.19	August	.60	.03	57	July	.21	.03	.18
								August	.11	.03	.08

September	.14	.02	.12	September	.28	.02	.26	September	.13	.02	.11
October	.14	.02	.12	October	.20	.02	.18	October	.08	.02	.06
November	.68	.01	.67	November	.19	.01	.18	November	.16	.01	.15
				December	.24	.01	.23				
				1893.							
				January	.37	.01	.36				
24 months	18.55	.40	18.15	21 months	17.58	.38	17.20	20 months	7.46	.37	7.09

TABLE No. 15.—*Low-water periods on Genesee River.*

[Gross rainfall at point of gaging, 1,070 square miles; above proposed dam, 1,000 square miles.]

First period.				Second period.			
Month.	Gross depth, in inches.	Evaporation from water surface.	Net run-off, in inches.	Month.	Gross depth, in inches.	Evaporation from water surface.	Net run-off, in inches.
1894.		*Per cent.*		1896.		*Per cent.*	
June	0.40	0.05	1.35	June	0.39	0.05	0.34
July	.33	.06	.08	July	.24	.05	.18
August	.22	.07	.15	August	.20	.05	.15
September	.21	.04	.19	September	.16	.03	.13
October	.44	.03	.41	October	1.74	.02	1.72
November	.82	.02	.80	November	.82	.02	.80
December	.61	.01	.60	December	.79	.01	.78
1895.				1897.			
January	.66	.01	.65	January	.78	.01	.77
February	.22	.01	.21	February	.79	.01	.78
March	1.94	.02	1.92	March	2.65	.02	2.63
April	2.01	.03	1.98	April	1.31	.03	1.28
May	.19	.06	.13	May	.99	.06	.93
June	.13	.06	.07	June	.44	.06	.38
July	.11	.05	.06	July	.46	.06	.40
August	.12	.04	.08	August	.44	.05	.39
September	.10	.03	.07	September	.18	.04	.14
October	.11	.02	.09	October	.18	.03	.15
November	.47	.01	.46	November	.37	.02	.35
December	1.32	.01	1.41	December	.95	.01	.94
1896.							
January	.47	.01	.46				
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Water-Supply and Irrigation Paper No. 81 Series M, General Hydrographic Investigations, 5

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DEPARTMENT OF THE INTERIOR
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CALIFORNIA HYDROGRAPHY

BY

JOSEPH BARLOW LIPPINCOTT

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF HYDROGRAPHY,
Washington, D. C., January 15, 1903.

SIR: I have the honor to transmit herewith a paper entitled "California Hydrography," by Mr. J. B. Lippincott, containing a summary of as much of the data concerning the water supply of California as is available from printed records and from observations of other engineers and investigations made by this Survey. The published records on the subject, hitherto much scattered, some of them out of print and difficult to secure, are here brought together, and the paper should therefore form a convenient and valuable book of reference for the use of engineers, irrigators, and all who are interested in the development of the valuable water resources of California.

For convenience in the use of the book the prominent drainage basins have been placed in alphabetic order, and the minor tributaries of the larger streams have been arranged alphabetically under the name of the trunk stream into which they discharge. The minor tributaries and irrigation ditches have in addition been cross-entered in alphabetic place, so that they may be found independently under their local names. The discharge measurements include both low-water and flood records and are accompanied by useful precipitation data.

Very respectfully,

F. H. NEWELL,
Hydrographer in Charge.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

CALIFORNIA HYDROGRAPHY.

By Joseph Barlow Lippincott.

INTRODUCTION.

The purpose of this publication is to assemble under one cover as much of the data concerning the water supply of California as is available from printed records, observations of other engineers, and investigations made by this Survey. The greater portion of the data are obtained from the latter source. The records of stream flow that have been published by the United States Geological Survey appear, first, in numerous Water-Supply Papers, which are published annually, soon after the end of the year's work, and contain a brief summary of the past year's operations, and, second, in large annual reports, showing the average monthly discharge and other records of streams in all portions of the United States. Thus, while the published record is complete, it is distributed through many volumes, and numerous investigators do not have a complete set of these publications.

The methods of stream measurement practiced by the Geological Survey are fully described in Water-Supply and Irrigation Paper No. 56. In brief, they usually consist of measuring the cross section of the stream with a tape and a sounding rod, and determining the velocity at numerous points in this cross section by means of a current meter, usually of the Price type. On large streams the meter measurements are usually made from cables. On small streams they are often made from foot bridges. The velocity observed is applied to each subdivision of the cross section where it is made, and the aggregate discharge of these cross sections is taken as the total discharge of the stream. On small streams weir measurements are often made.

When a record of daily flow is to be kept on any river a gage rod is established on the stream near the point of measurement, and the height of the water on this rod is observed and recorded at the time each measurement is made. By properly selecting periods of high, low, and average water for the times of measurement it is possible to

formulate a rating or discharge curve for the river in terms of volume discharged and water height on the rod. A local observer is employed to read the rod daily, and from these observed rod readings a statement of daily, monthly, and annual discharge is deduced.

Some of the data given were contributed by irrigation and power companies from daily records kept at their head works. In cases of this kind due credit is given.

The reports compiled and published by the California State engineering department between the years 1878 and 1884[a] are now out of print and hard to obtain. The information contained in them is therefore included in this paper. The method of stream measurement most commonly practiced by the State engineering department consisted of stretching two wires across the stream at a fixed distance apart and noting the time of passage of floats through the section observed from the upper to the lower wire. Cross-sectional areas were measured and the velocities indicated by the floats were applied thereto, thus determining the discharge. Daily records of river heights on gage rods were kept on a number of the streams in a manner similar to that practiced by the United States Geological Survey. A rating table for the station was obtained from the discharge measurements, and, by applying it to the daily rod readings, monthly and annual discharge tables were determined. In several instances, however, where records have been kept on neighboring streams the State engineering department has prepared theoretical discharge estimates of other streams in the same locality by using the rate of run-off per square mile obtained from a measured stream and applying it in determining the probable run-off from the basin of a neighboring stream. In cases of this kind the discharge figures are marked with a star. In each instance the effort has been made to give the date of the measurement, the name of the observer, the volume discharged, and a description of the locality and stream.

The measurements have been grouped in the principal drainage basins, but it would obviously be impossible to adhere rigidly to this arrangement. For instance, all the streams of the San Joaquin Valley are, technically speaking, tributary to San Joaquin River, but it would be manifestly improper to include all the main rivers from the Sierras in this section under the head of San Joaquin River. The rule therefore has been adopted of giving each prominent drainage basin its place in alphabetic sequence; the minor tributaries of these large streams are then arranged alphabetically under the name of the trunk stream into which they discharge. For instance, Tuolumne River is considered an independent stream, but Eleanor Creek, Falls Creek, etc., are considered minor tributaries and are arranged under the heading "Tuolumne River." The effort has been made, however,

[a] No measurements were made by the California State engineering department subsequent to 1884, as the office was then discontinued.

MAP OF
CALIFORNIA
SHOWING RIVER GAGING STATIONS
AND DISTRIBUTION OF RAINFALL
The curved lines showing distribution of rainfall were compiled largely by Marsden Manson for the California Water and Forest Association, in collaboration with the Hydrographic Branch of the United States Geological Survey. They are given as approximations subject to revision.
Scale
25 0 25 50 75 100 miles
LIST OF
GAGING STATIONS
1. McCLOUD RIVER HERZ MOUNTAIN
2. SACRAMENTO RIVER JELLY'S FERRY
3. " " IRON CANYON
4. STONY CREEK JULIANS
5. FEATHER RIVER OROVILLE
6. TRUCKEE RIVER STATE LINE
7. CACHE CREEK LOWER LAKE
8. " " YOLO BRIDGE
9. MOKELUMNE RIVER ELECTRA
10. STANISLAUS RIVER OAKDALE
11. TUOLUMNE RIVER JACKSONVILLE
12. " " LAGRANGE
13. " " MODESTO
14. MERCED RIVER MERCED FALLS
15. SAN JOAQUIN RIVER HERNDON
16. KING RIVER. RED MOUNTAIN
17. " " KINGSBURG
18. SALINAS RIVER. SALINAS
19. ARROYO SECO FOSTER'S RANCH
20. " " PETTIT'S RANCH
21. SAN LORENZO CREEK KING CITY
22. SAN ANTONIO CREEK JOLON
23. NACIMIENTO CREEK HARRIS'S RANCH
24. TULE RIVER McFARLAND'S RANCH
25. KERN RIVER KERNVILLE
26. " " BAKERSFIELD
27. LITTLE ROCK CREEK PALMDALE
28. MOHAVE RIVER VICTORVILLE
29. SANTA YNEZ RIVER
30. TRIUNFO CREEK
31. MALIBU CREEK
32. LOS ANGELES RIVER LOS ANGELES
33. ARROYO SECO TERMINAL QUARRY
34. SAN GABRIEL RIVER AZUSA
35. LYTLE CREEK MOUTH OF CANYON
36. SANTA ANA RIVER WARM SPRINGS
37. " " " RINCON
38. SAN LUIS REY RIVER ESCONDIDO
39. SWEETWATER RIVER. DAM
40. COLORADO RIVER YUMA
41. " " BULLS HEAD
DEL NORTE
SISKIYOU
MODOC
SHASTA
LASSEN
HUMBOLDT
TRINITY
TEHAMA
PLUMAS
MENDOCINO
SIERRA
CHURCHILL
LYON
LANDER
DOUGLAS
EL DORADO
ALPINE
MONO
TUOLUMNE
MARIPOSA
MERCED
SAN JOAQUIN
STANISLAUS
CONTRA COSTA
ALAMEDA
SANTA CLARA
SANTA CRUZ
MONTEREY
SAN BENITO
FRESNO
INYO
KINGS
TULARE
KERN
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
SAN DIEGO
NYE
ORANGE
Mt Shasta
Lassen Peak
Pt Delgada
Pt Arena
Pt Tomales
Pt de los Reyes
Pt Bonita
Pt Lobos
Pt Pinos
Pt Sur
Pt San Luis Obispo
Pt Sal
Pt Arguello
Pt Conception
SANTA BARBARA CHANNEL
San Miguel I.
Santa Rosa
Santa Cruz
Anacapa I.
Santa Barbara I.
San Nicholas I.
Santa Catalina I.
San Clemente I.
Pt Vincent
Oceanside
False Pt
Pt Loma
San Diego
Ft Mohave
Needles
Yuma
Death Valley
Colorado River
Mojave River
Santa Ana River
Santa Monica Bay
Salinas River
Sacramento River
Feather River
Truckee River
Tuolumne River
Merced River
San Joaquin River
Kern River
Mokelumne River
Stanislaus River
Cache Creek
Stony Creek
Eureka
Redding
Susanville
Sacramento
Stockton
Fresno
Bakersfield
Los Angeles
San Bernardino
Riverside
San Diego
Yuma
Austin
Bishop
Bodie
Mariposa
Monterey
Santa Cruz
Ventura
Santa Barbara
San Luis Obispo
Mojave
Needles
Ft Mohave
Yuma
Bullhead City
Oroville
Marysville
Nevada City
Placerville
Jackson
Sonora
Modesto
Merced
Hanford
Visalia
Porterville
Lone Pine
Independence
Ukiah
Eureka
Redding
Susanville
Truckee
Carson City
Reno
Winnemucca
Elko
Ely
Tonopah
Goldfield
Beatty
Pyramid Lake
Walker Lake
Mono Lake
Owens Lake
Salton Sea
Tulare Lake
Clear Lake
Shasta Lake
Lake Tahoe
Pyramid Lake
Walker Lake
Mono Lake
Owens Lake
Salton Sea
Tulare Lake
Clear Lake
Shasta Lake
Lake Tahoe
Pacific Ocean
Gulf of California
Southern Pacific R.R.
Atchison Topeka & Santa Fe R.R.
Southern Pacific R.R.
Central Pacific R.R.
Nevada Central R.R.
Colorado River Indian Reservation
Tonto Indian Reservation
San Bernardino Forest Reserve
San Gabriel Forest Reserve
Santa Monica Forest Reserve
Cleveland Forest Reserve
Angeles Forest Reserve
Santa Barbara Forest Reserve
Los Angeles Forest Reserve
Sierra Forest Reserve
Sierra Forest Reserve
Sierra

to cross-enter all these minor tributaries, so that they may be found independently under their local names, reference being made to the trunk stream into which they discharge.

Undoubtedly many measurements that are not available for this publication have been made for corporations and individuals by engineers of California. These data, if they could be obtained, would doubtless be of great value, and the suggestion is here made that it would be a public benefit to send this information to the United States Geological Survey, where it would be available for publication in subsequent bulletins of this nature.

The records of the Signal Service and Weather Bureau are also contained in annual reports extending over a long term of years, and the engineer who possesses a complete file of these publications is indeed fortunate.

The rain water which forms the source of the water supply for agriculture in California falls in large part upon the mountain ranges of the State. It is a well-known fact that within the State there are vast differences in rainfall with increase or decrease of elevation, particularly on the western slopes of the mountain ranges. Rainfall statistics have been compiled in great mass for the valley districts, where farming is actually carried on, but the engineer who is investigating plans for storage and power is much more interested in the rainfall of the mountains. An attempt has been made to include in this paper all available data relative to precipitation at the higher elevations. The Weather Bureau publishes its records of precipitation in calendar years, beginning with the 1st of January, which is the middle of the rainy season on the California coast. A record beginning on the 1st of January may show for that and following months conditions of excessive drought, while for the following November and December of the same calendar year it may give records of excessive rainfall, the result indicated for the calendar year being a mean rainfall, whereas there may have been a dry season followed by one of excessive precipitation. For this reason the rainfall records for the mountain districts have been classified in seasonal years, and it is believed that their presentation in this form will avoid for the engineer many laborious retabulations of results. Particular effort has been made to collect and present new data.

Each table of precipitation is accompanied with a statement showing the approximate position of the station and its elevation, as well as the authority for the record. These records are in part taken from the annual reports of the Weather Bureau and rearranged in seasonal instead of calendar years, as stated above. All the regular stations of the United States Weather Bureau are situated at relatively low elevations with the exception of Mount Tamalpais, but some voluntary observers report to the Weather Bureau from mountain sta-

tions. These observers use a variety of measuring devices. Some use glass graduates, with various-sized catchment cups, and some employ more primitive implements. The records of mountain precipitation, however, are so scarce that they are all given here, because it is believed that any information tending to throw light on this subject is of value.

All the records that are credited to the Southern Pacific Railroad were obtained from Mr. William Hood, chief engineer of the system. The rain gages used by the railroad company are small gages with 3-inch catchment cups, usually set on posts about 6 feet in height, and the observations are made by the local railroad agents. Their reports are sent in promptly to San Francisco and are there tabulated by a corps of clerks whose time is devoted entirely to this subject.

In many places in the high mountain districts, particularly at the greatest elevations, the gages have been lately furnished by the hydrographic branch of the United States Geological Survey. The gages used in these places are of the standard type, with an 8-inch measuring cup. Snow observations are made by melting the snow and reporting the resultant water.

RELATION OF RAINFALL TO RUN-OFF IN CALIFORNIA.

DIAGRAMS AND TABLES.

The accompanying diagrams and tables are presented as the result of a study of the available rainfall and run-off data for California watersheds.

As the run-off diagram was to be used in estimating the water supply available for various storage reservoirs for irrigation, it was thought best to represent the run-off in acre-feet per square mile. The majority of the discharge reports give the depth of run-off in inches. The accompanying table has been made for converting depth of run-off in inches to run-off in acre-feet per square mile, the following formula being used:

Depth of run-off in inches $\times (0.0833 \times 640) =$ run-off in acre-feet per square mile.

Table for converting depth of run-off in inches into acre-feet per square mile.

Depth of run-off.	Acre-feet per square mile.	Depth of run-off.	Acre-feet per square mile.	Depth of run-off.	Acre-feet per square mile.	Depth of run-off.	Acre-feet per square mile.
Inches.		*Inches.*		*Inches.*		*Inches.*	
0.01	0.533	0.26	13.867	0.51	27.200	0.76	40.533
.02	1.067	.27	14.400	.52	27.733	.77	41.067
.03	1.600	.28	14.933	.53	28.267	.78	41.600
.04	3.133	.29	15.467	.54	28.800	.79	42.133
.05	2.667	.30	16.000	.55	29.333	.80	42.667
.06	3.200	.31	16.533	.56	29.867	.81	43.200
.07	3.733	.32	17.067	.57	30.400	.82	43.733
.08	4.267	.33	17.600	.58	30.933	.83	44.267
.09	4.800	.34	18.133	.59	31.467	.84	44.800
.10	5.333	.35	18.667	.60	32.000	.85	45.333
.11	5.867	.36	19.200	.61	32.533	.86	45.867
.12	6.400	.37	19.733	.62	33.067	.87	46.400
.13	6.933	.38	20.267	.63	33.600	.88	46.933
.14	7.467	.39	20.800	.64	34.133	.89	47.467
.15	8.000	.40	21.333	.65	34.667	.90	48.000
.16	8.533	.41	21.867	.66	35.200	.91	48.533
.17	9.067	.42	22.400	.67	35.733	.92	49.067
.18	9.600	.43	22.933	.68	36.267	.93	49.600
.19	10.133	.44	23.467	.69	36.800	.94	50.133
.20	10.667	.45	24.000	.70	37.333	.95	50.667
.21	11.200	.46	24.533	.71	37.867	.96	51.200
.22	11.733	.47	25.067	.72	38.400	.97	51.733
.23	12.267	.48	25.600	.73	38.933	.98	52.267
.24	12.800	.49	26.133	.74	39.467	.99	52.800
.25	13.333	.50	26.667	.75	40.000	1.00	53.333

At the outset many difficulties presented themselves. The most serious one was that of obtaining measurements of rainfall at the higher elevations. The streams having the largest run-off, and on which discharge records had been kept, have their sources on the western slopes of the high Sierra Nevada, where there are few or no inhabitants above 7,000 feet, and consequently no observers of rainfall; but the valuable rainfall records of the Pacific Railway system along the line of railway from Sacramento to the summit of the Sierra Nevada at Railroad Pass offered a solution of this difficulty. In fig. 1 the mean rainfall and the elevation of the station are plotted as ordinates, and the distance inland of the station as abscissas.

The rate of increase of precipitation from Sacramento to Cisco, at the elevation of 6,000 feet, the point of maximum rainfall, seems to

be 0.6 inch per 100 feet of rise. The precipitation above the 6,000-foot point decreases with the elevation approximately at the rate of 0.4 inch per 100 feet of rise.

Fortunately, in Tuolumne River Basin, about midway between American and King river basins, there is another series of rainfall stations, including Lagrange, elevation 293 feet above sea level; Sonora, elevation 1,824 feet; Second Garrote, elevation 2,900 feet, and Crockers, elevation 4,453 feet. The mean rainfall of these stations, plotted as in the above diagram, indicates the rate of increase from Lagrange to Crockers to be 0.84 inch per 100 feet of rise. This rate of increase has been taken to hold good up to an elevation of 6,000 feet, and above this the rate of decrease of rise to be 0.4 inch per 100 feet to an elevation of 9,000 feet. Probably the rate of increase and

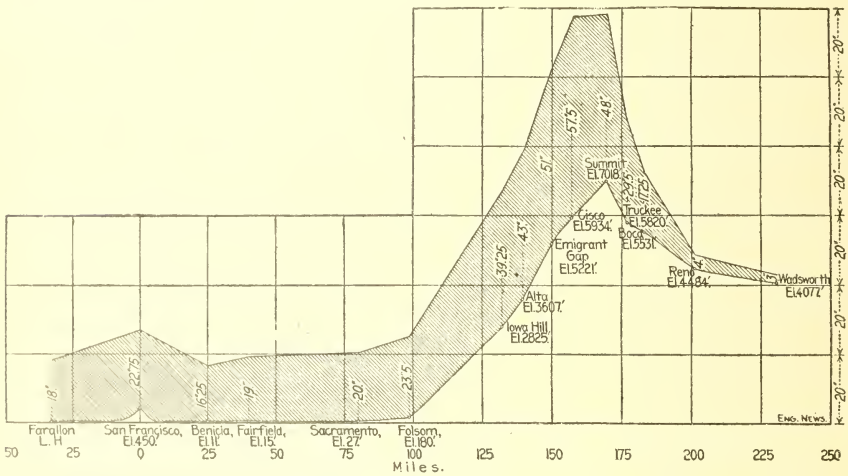

FIG. 1.—Diagram showing increase of rainfall with rise in elevation over the Sierras in central California.

decrease would be more correctly represented by a curved line, but the data are not sufficient to warrant such representation.

At these rates of increase and decrease, the mean precipitation for the years 1896–1899, at an elevation of 9,000 feet in the Tuolumne River Basin, would be 49.8 inches; if snow converts into water at the ratio of 8 to 1, the snowfall would be 33.2 feet at this elevation.

It was found impossible to use the run-off data of Kern River Basin—though that stream is without doubt more closely watched than any other stream in the State and the record is the oldest for any large stream in the State—because of the exposure of the watershed and because of the scarcity of rainfall data. This watershed is bounded on the west for almost its entire length by a high mountain range. Concerning the precipitation on the eastern slope of this range, little is known beyond the fact that it is very much less than on the western slope.

In 1896 the total run-off from King River Basin, comprising 1,775 square miles, was 1,871,005 acre-feet. For the same year the run-off from Kern River Basin was 619,630 acre-feet. The ratio of the area of King River Basin to Kern is 1 to 1.32, and the ratio of run-off, 1 to 0.33, though the higher drainage areas of the streams are contiguous. It was also thought best not to use the run-off and rainfall data for Piru Creek Basin, furnished by the Antelope Valley Water Company, because the ratio of discharge in acre-feet per square mile was greater than any other record. There is little doubt about the accuracy of both the run-off and precipitation records, the explanation being that the rainfall observation stations were necessarily situated at so low an elevation that the record did not represent the mean rainfall for the higher portions of the basin.

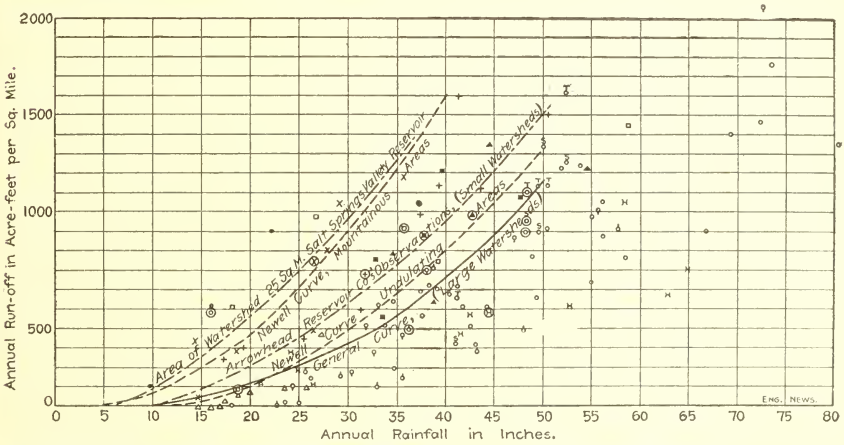

FIG. 2.—Annual and mean run-off from California watersheds, based on several years' observations.[a]

The run-off and rainfall data of the streams which were used to make the discharge diagram, fig. 2, will be mentioned in the order from north to south in which their watersheds occur.

STATISTICS BY BASINS.

Sacramento River Basin.—The rainfall stations used in determining the mean annual precipitation for Sacramento River Basin were the following: Red Bluff, Rosewood, Redding, Delta, Dunsmuir, Shasta, Sisson, and Fort Bidwell.

There were absolutely no records for the great interior mountain-

[a] For derivation of "Newell curves," see Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1894, p. 151.

ous and lava country in Siskiyou, Modoc, and Lassen counties, comprising more than 5,334 square miles of the watershed.

Fort Bidwell is situated outside of the watershed, on the eastern slope of the mountains that form the boundary, and would probably have a less rainfall than Modoc County. The record was kept there for a period of twenty-two years, and the mean rainfall is 20.8 inches.

The average rainfall at Red Bluff for a period of twenty-three years was 23.9 inches; at Rosewood, for a period of six years, 25.63; at Redding, for twenty-four years, 35.69 inches. The precipitation at these three latter stations was taken to get the average for Sacramento Valley for the years 1896-1899, during which years run-off measurements were made at Jellys Ferry. The mean rainfall of Pit River drainage area (5,334 square miles), which has an average elevation of 5,000 feet, was taken to be the same as that of the Sacramento Basin above Red Bluff.

The average rainfall at Delta for a period of fourteen years was 62.39 inches; at Dunsmuir, for ten years, 57.16 inches; at Shasta, for six years, 53.26 inches; at Sisson, for ten years, 32.75 inches. The rainfall at these four stations was taken to obtain the mean rainfall for the mountainous area of the watershed for the years 1896–1899.

San Mateo Creek.—The Spring Valley Water Company's record of rainfall and run-off from the watershed of San Mateo Creek is without doubt the oldest record in the State, having been kept for thirty years. In the table given on page 390 of Water-Supply and Irrigation Paper No. 38 of the United States Geological Survey, no allowance has been made for evaporation from the surface of the reservoir; 20 per cent has here been added to the run-off as calculated from those tables to cover evaporation. The drainage basin of San Mateo Creek ranges in elevation from 250 to 1,800 feet, with an average of about 750 feet. The hills are undulating. There is a limited growth of timber on the northern slopes near the summit, but a large amount of brush covers other portions of the basin. On the southern slopes and crest the hills are frequently bare of brush, but are covered with grasses.

Salt Springs Valley watershed.—The basin of Salt Springs Valley is largely of red clay, which scantily covers a bed rock of granite and slate. The topography is undulating rather than mountainous, about 20 per cent of the total drainage area being valley land. There is little brush or timber in the valley, and only a scattered growth of oak and scrubby pine on the hills. To obtain the mean for the basin 10 per cent has been added to the rainfall for North Hill, 6 miles northwest of the dam. To obtain the total run-off for the basin 4,132 acre-feet have been added to the amounts given in the table on page 337, Part IV, of the Eighteenth Annual Report of the United States Geological Survey, to compensate for evaporation from the reservoir surface.

The methods of measurement of discharge from the reservoir are

very crude, and this may partly account for the very high percentage of run-off from this basin, which contains 25 square miles.

Stanislaus River Basin.—No rainfall data were obtained for this basin, but since it joins the Tuolumne and is in most respects similar to that, the rainfall for Tuolumne Basin has been taken to apply to both.

Tuolumne River Basin.—To obtain the mean rainfall for this basin the average elevations and the areas of the various portions were taken from the topographic maps of the United States Geological Survey. The areas were obtained by the use of a planimeter. La Grange was taken as the base station, and the percentage of increase for the various elevations is shown by the diagram, fig. 1. The following example, for the year 1896, will illustrate more particularly the method:

Table of estimated rainfall, Tuolumne River Basin.

Average elevation.	Number of square miles.	Estimated rainfall, 1896.	Mile-inches.
1,200	75	26.4	1,980
1,500	88	29.0	2,552
2,500	182	37.4	6,807
3,500	46	45.8	2,107
4,000	105	50.0	5,252
4,500	147	54.2	7,967
5,500	90	60.9	5,481
6,000	143	63.3	9,052
6,500	105	61.3	6,437
7,500	189	57.3	10,830
9,000	330	51.3	16,927
1,500	----------	----------	75,692

$$\frac{75,692}{1,500} = 50.3 \text{ inches mean for basin, 1896.}$$

San Joaquin and King river basins.—There were practically no rainfall data for either San Joaquin or King River Basin.

The estimated mean rainfall for Tuolumne River Basin for the years 1896–1899 is 48.2 inches; the depth of mean run-off for the same period is 20.8 inches; the depth of mean run-off for San Joaquin River for this period is 18.4 inches. Since the topography, exposure, etc., in the two basins are similar, the rainfall will probably be proportional to the run-off.

Example, 20.8 : 18.4 : : 48.2 : 42.7. Similarly, the mean rainfall for King River Basin will be 37.8 inches.

Mohave River.—The meteorologic and hydrographic work of the Arrowhead Water Company has been carried on for a number of years at the head of Mohave River. Twenty-eight rain gages, carefully located at elevations of from 2,100 to 7,200 feet, have been maintained. The measurements of run-off from several tributaries have been made over weirs. The areas of the basins are each less than 50 square miles. The watershed is covered with a thick growth of timber on the crest. The growth of timber diminishes as the desert is approached, the northern part of the watershed being covered with brush only. The mean elevation of the watershed above sea level is about 5,250 feet.

Cuyamaca reservoir watershed—The area of this watershed is 11 square miles and the mean elevation above sea-level is probably 5,500 feet.

The run-off is carefully measured. There is only one rain gage maintained, and that is at the dam. The resident engineer, Mr. F. S. Hyde, says that as this rain gage is located between two high wooded peaks, which act as condensers of the moisture-laden clouds, the recorded precipitation is undoubtedly heavier than the average of the watershed. This probably explains why the mean annual run-off is so far below the general curve.

Sweetwater reservoir basin—The evaporation and run-off records from this basin date from 1888, and have been very carefully kept.

There is no doubt that many of the points on the curves (fig. 2) would be changed if we had more definite information as to the rainfall, but the curves are the best that could be made from the information at hand. The mean discharge for the period of observation on each stream is used, together with the mean rainfall for the same years. These means are considered the more satisfactory, as they tend to eliminate erratic stream and rainfall records.

EVAPORATION.

LAKE TAHOE.

On May 17, 1900, a galvanized-iron tank, 2 feet square and 2 feet deep, was placed in Lake Tahoe at its outlet, where it would be protected from the heavy waves of the lake, for the purpose of measuring the evaporation from the lake surface. A finely divided scale was placed in this tank, and daily readings taken at about the same hour of each day by Mr. J. U. Haley, general freight and passenger agent of the Lake Tahoe Railway and Transportation Company. The tank was at all times kept full to within 1 or 2 inches of the top, and was floated by means of a timber frame, which also served as a protection from waves and drift, so that the water level inside and outside was about the same. The depth of water in which the tank was anchored was about 6 feet, and the water in the tank was fully exposed to wind and

sun. The following table shows the monthly evaporation from May 17 to November 30.[a]

Evaporation at Lake Tahoe, as measured in tank in lake at Tahoe City.

Date.	Depth in inches.
1900.	
May 17 to 31	1.83
June	3.80
July	4.00
August	5.15
September	3.10
October	2.15
November	1.38
Total	21.41

While it is possible that the evaporation from the lake surface was somewhat greater than from the tank, owing to its greater roughness and consequent greater surface, relatively, in contact with the air during high winds, it is believed that the results here given are as near to the truth as it is possible to attain, and that they represent very closely the loss of water which may be expected from evaporation from natural lakes or storage reservoirs situated at about 6,000 feet altitude in this portion of the Sierras during the period over which the record extends.

RENO, NEV.

During the year 1894, from May 11 to November 30, a series of observations were made at Reno, Nev., with a view to determining approximately the depth of evaporation at that point. For this purpose a small galvanized-iron tank, 18 inches square and 18 inches deep, was sunk in the ground until the rim was but half an inch above the surface. This was kept filled to within less than 1 inch of the top at all times and was so placed that it was fully exposed to the sun and wind. The earth immediately around the tank was kept wet. The results, while not absolutely reliable as an index to the actual evaporation from a lake reservoir or canal surface, are believed to be a fairly close approximation to what would occur from such a surface at Reno, and since the conditions influencing evaporation—temperature, humidity of atmosphere, winds, etc.—over the lower portion of the Truckee River Basin are nearly identical with those at Reno, they should be roughly applicable to other points in that portion of the basin.

[a] Taylor, H. L., Water storage in the Truckee Basin: Water-Sup. and Irr. Paper No. 68, U. S. Geol. Survey, 1902.

Evaporation from tank in earth at Reno, Nev.

Date.	Depth in inches.
1894.	
May 11 to 31	2.80
June	5.35
July	8.45
August	9.12
September	7.44
October	4.31
November	2.75
Total	40.22

SWEETWATER RESERVOIR.

The following table shows the amount of evaporation, wind movement, humidity, and temperature at Sweetwater reservoir for a series of years:

Annual evaporation, temperature, etc., in Sweetwater Basin, San Diego County.

[Elevation of reservoir, 250 feet.]

Period.	Evaporation.	Wind.	Humidity.	Temperature of air.	Temperature of water.
	Inches.	*Miles per hour.*	*Per cent.*	°*F.*	°*F.*
1889–90	56.47	4.9			
1890–91	57.54	4.6			
1891–92	58.65	4.8	72	61	68
1892–93	49.60	4.9	68	61	67
1893–94	48.68	5.1	70	60	67
1894–95	46.31	5.2	79	59	
1895–96	45.18	5.2	71	61	
1896–97	[a] 41.24	5.3	76	61	
1897–98	61.93	5.9	73	60	
1898–99	[b] 32.54	5.8	72	59	

[a] Evaporation January 1 to August 31. [b] Evaparation September 1 to April 30.

KERN AND TULARE COUNTIES.[a]

To ascertain the amount of evaporation from exposed surfaces of water, experiments have been made in Kern County at various points, and in Tulare County at Kingsburg.

The experiments in Kern County commenced in the latter part of

[a] Authority, Physical Data and Statistics of California.

June, 1879, and were continued at several localities through July, August, and September, the three hottest months of the year. Subsequently observations were made until December 20, 1879, at Rio Bravo ranch, about 10 miles east of Bakersfield. The experiments at Kingsburg, Tulare County, commenced on November 1, 1881, and were continued to November 1, 1885.

In making the Kern County experiments pans of galvanized iron 2 feet square and 1 foot deep were used, some of the observations being made in pans floated in large bodies of water, and others in pans set in open ground, as will be explained more fully for each of the records.

The pans used in making the later observations at Kingsburg were 3 feet square and 15 inches deep. The water surface was maintained about 5 inches below the rim of the pan.

The amount of water required from time to time to maintain its surface in the pans at a fixed height was measured in standard cups prepared for the purpose and graduated to represent depth of water in the pan for which they were used.

When floated in a lake or river the pans were protected from the splash of waves. The contrivance used in King River, at Kingsburg, for this purpose was a large wooden frame, into which the pan was fitted so as to float horizontally, but not be protected from the sun or movement of the air.

Observers at Kingsburg were instructed, among other things—

To fill the pan to the normal plane once every day during the summer months; less frequently at other seasons of the year.

To take an observation at the commencement of every fall of rain, and to restore the water surface to the normal plane at the end of every fall of rain.

To keep a daily record of the temperature of the air, of the water in the pan, and of the water surrounding the pan.

To keep a rainfall record.

The earlier observations made in Kern County were conducted less systematically, but still with sufficient care and thoroughness to serve a good purpose.

The results of the observations made in Kern County are embodied in Tables No. 1 to 6, which are a rearrangement of data published by the State engineering department in the report of 1880.

In Table No. 1 are given the results of the experiment made in Reeder Lake, which is a narrow body of water, 12 to 15 feet deep, surrounded by large cottonwood trees and willows. The pan was placed in a shallow arm of the lake, fully exposed to the sun, but protected from the wind.

Panama Slough (see Table No. 2) was selected for another set of observations. The pan was placed in running water 10 feet deep, showing a much lower temperature than Reeder Lake. It was fully exposed to the sun, but protected from the wind.

The pan in the center of Kern Lake (Table No. 3) was about 2 miles from shore, in 5 feet of water. On September 5, 13, and 29 the wind was northwest; on September 19 it was southwest.

The pan near the shore of Kern Lake (Table No. 4) was placed on the northeast side of the lake, in about 2 feet of water.

In Tables No. 5 and 6 are given the results of observations made at the Rio Bravo ranch, 3 miles below the mouth of Kern River Canyon. The pan in Kern River was freely exposed to sun and wind, but was immersed in water to within 2 inches of its top. The pan placed on top of the ground was free to the action of all elements, producing extreme evaporation.

In Tables No. 7 to 11 are presented, in condensed form, the results of observations covering a period of four years. The total depth of water evaporated during each month, each period of three months, and each year is given in a separate table for each of the four years. The tables contain also the averages of daily temperature records.

Table No. 11 is one of averages, in which columns are added, showing the rate of evaporation per twenty-four hours, and the amount evaporated per second per square mile, during the different time periods.

The pan in the air referred to in the Kingsburg tables was, after the first three months, set into the ground, earth being banked up around its sides to the same elevation as the water in it. Its surface was fully exposed to sun and wind. During November and December, 1881, and January, 1882, this pan was on the railroad bridge, exposed on all sides to sun and air.

Evaporation at several points in Kern County, June to December, 1879.

TABLE NO. 1.—PAN IN REEDER LAKE.

Date.	Time of day.	Temperature (degrees F.).			Evaporation (depth in feet).	Evaporation per 24 hours (depth in feet).	Evaporation in cubic feet per second per square mile.
		Water in pan.	Water surrounding pan.	Air.			
1879.							
June 23	9.55 a. m	.....	.....	.....	.....	.....	.....
June 23 to 25	6.25 a. m	83	.....	92	0.040	0.0168	5.42
June 25 to 28	7.50 p. m	81	.....	90	.068	.0222	7.12
June 28 to 30	5 p. m	82	.....	79	.035	.0187	6.04
June 30 to July 5	4.50 p. m	87	.....	73	.096	.0192	6.20
July 5 to 8	5 p. m	92	.....	77	[a] .072	[a] .0240	[a] 7.74
June 23 to July 8.	.....	.....	.....	.....	.311	.0203	6.56

[a] Water fell, leaving the pan at the top 6 inches above water surface.

Evaporation at several points in Kern County, June to December, 1879—Cont'd.

TABLE No. 2.—PAN IN PANAMA SLOUGH.

Date.	Time of day.	Temperature (degrees F.).			Evaporation (depth in feet).	Evaporation per 24 hours (depth in feet).	Evaporation in cubic feet per second per square mile.
		Water in pan.	Water surrounding pan.	Air.			
1879.							
July 9	12.30 p. m						
July 9 to 11	6.20 p. m	72		76	0.030	0.0134	4.34
July 11 to 21	9 a. m						
July 21 to 24	6.50 p. m			88	.037	.0108	3.48
July 24 to 29	6.15 p. m	76	71	88	.054	.0108	3.48
July 29 to August 5.	7 p. m	79	77	92			
August 5 to 13	7 a. m	72	74	76			
August 13 to 20	6.45 a. m	64	67	68	.084	.0120	3.87
July 9 to August 20.					[a] .490	[a] .0116	[a] 3.74

[a] Approximate.

TABLE No. 3.—PAN IN CENTER OF KERN LAKE.

1879.							
August 30	10.40 a. m	88	86	90			
August 30 to September 5.	11.30 a. m	89	81	90	0.105	0.0175	5.63
September 5 to 13	12.30 p. m	86	86	118	.096	.0119	3.90
September 13 to 19	12.05 p. m	86	86	120	.150	.0250	8.08
September 19 to 29	12.10 p. m	78	78	88	.180	.0180	4.80
August 30 to September 29.					.531	.0173	5.70

TABLE No. 4.—PAN NEAR SHORE OF KERN LAKE.

1879.							
August 14	10.40 a. m						
August 14 to 30	10.40 a. m	88	86	90	0.480	0.0300	9.67
August 30 to September 5.	11.10 a. m	79	83	90	.201	.0334	9.31
September 5 to 13	12 m	88	90	118	.195	.0242	7.81
September 13 to 19	12 m	81	89	120	.156	.0259	8.36
September 19 to 29	12 m	76	80	88	.189	.0190	6.13
August 14 to September 29.					1.221	.0265	8.55

Evaporation at several points in Kern County, June to December, 1879—Cont'd.

TABLE No. 5. PAN IN KERN RIVER AT THE RIO BRAVO RANCH.

Date.	Time of day.	Temperature (degrees F.).			Evaporation (depth in feet).	Evaporation per 24 hours (depth in feet).	Evaporation in cubic feet per second per square mile.
		Water in pan.	Water surrounding pan.	Air.			
1879.							
October 2							
October 2 to 11	4 p. m.	66	64	74	0.104	0.0116	3.73
October 11 to 18	4 p. m.	68	66	84			
October 18 to 25	4 p. m.	68	66	78	.052	.0074	2.38
October 25 to November 1.	4 p. m.	62	61	67	.052	.0074	2.38
November 1 to 8	4 p. m.	55	55	63	.045	.0064	2.06
November 8 to 15	4 p. m.	56	56	62			
November 15 to 22	4 p. m.	54	54	64	.030	.0043	1.38
November 22 to 29	4 p. m.	53	53	68	.030	.0043	1.38
November 29 to December 6.	4 p. m.	52	52	54	.030	.0043	1.38
December 6 to 13	4 p. m.	50	50	54	.030	.0043	1.38
December 13 to 20	4 p. m.	52	52	54	.030	.0043	1.38
October 2 to December 20.					[a].408	[a].0052	[a]1.67

[a] Approximate.

TABLE No. 6.—PAN ON OPEN GROUND AT THE RIO BRAVO RANCH.

1879.							
October 2	7 a. m.						
October 2 to 3	4 p. m.	68		94	0.037	0.0292	9.40
October 3 to 11	4 p. m.	68		74	.148	.0180	5.80
October 11 to 18	4 p. m.	80		84	.071	.0101	3.25
October 18 to 25	4 p. m.	78		78	.147	.0210	6.76
October 25 to November 1.	4 p. m.	70		67	.148	.0211	6.79
November 1 to 8	4 p. m.	58		63	.113	.0176	3.46
November 8 to 15	4 p. m.	65		62	.030	.0043	1.38
November 15 to 22	4 p. m.	64		64	.070	.0100	3.22
November 22 to 29	4 p. m.	62		68	.052	.0074	2.38
November 29 to December 6.	4 p. m.	58		54	.015	.0021	.68
December 6 to 13	4 p. m.	55		54	.037	.0053	1.71
December 13 to 20	4 p. m.	55		54	.037	.0053	1.71
October 2 to December 20.					.906	.0115	3.70

Evaporation at Kingsburg Bridge, King River.

TABLE NO. 7.—NOVEMBER 1, 1881, TO OCTOBER 31, 1882.

[Elevation 297 feet.]

Date.	Time of day.	Temperature of air.	Pan in river.			Pan in air.	
			Temperature of water in river.	Temperature of water in pan.	Evaporation (depth in feet).	Temperature of water in pan.	Evaporation (depth in feet).
1881.							
November	4.30 p. m	66	56	55	0.220	60	0.335
December	4.30 p. m	55	52	52	.050	55	.120
1882.							
January	4.30 p. m	54	52	50	.090	53	.200
February	5 p. m	56	55	54	.115	56	.105
March	5.15 p. m	64	60	59	.180	66	.265
April	5.15 p. m	73	63	62	.260	72	.435
May	5.45 p. m	84	63	63	.305	77	.835
June	6.30 p. m	88	67	68	.475	83	.940
July	6.30 p. m	98	80	81	.660	91	1.075
August	6 p. m	96	84	85	.665	85	.875
September	6 a. m	81	73	73	.475	75	.575
October	10 a. m	68	63	63	.135	60	.195
November to January.[a]					.360		.655
February to April[b]					.555		.805
May to July[c]					1.440		2.850
August to October.[d]					1.275		1.645
Total, November to October.					3.630		5.955

[a] First period. [b] Second period. [c] Third period. [d] Fourth period.

Evaporation at Kingsburg Bridge, King River—Continued.

TABLE NO. 8.—NOVEMBER 1, 1882, TO OCTOBER 31, 1883.

Date.	Time of day.	Temperature of air.	Pan in river.			Pan in air.	
			Temperature of water in river.	Temperature of water in pan.	Evaporation (depth in feet).	Temperature of water in pan.	Evaporation (depth in feet).
1882.							
November	10 a. m.	53	52	52	0.115	49	0.100
December	10 a. m.	51	50	50	.085	46	.090
1883.							
January	10 a. m.	43	44	43	.060	41	.040
February	10 a. m.	54	50	49	.100	52	.070
March	10 a. m.	69	63	62	.305	60	.310
April	10 a. m.	67	61	62	.270	61	.260
May	10 a. m.	76	61	63	.160	67	.310
June	10 a. m.	92	68	71	.500	77	.850
July	10 a. m.	96	82	84	.760	78	.970
August	10 a. m.	93	82	83	.920	75	.970
September	10 a. m.	88	78	79	.730	73	.705
October	10 a. m.	69	62	62	.400	57	.290
November to January.[a]	10 a. m.	49	49	48	.260	45	.230
February to April[b]	10 a. m.	63	58	58	.675	58	.640
May to July[c]	10 a. m.	88	70	73	1.420	74	2.130
August to October.[d]	10 a. m.	83	74	75	2.050	68	1.965
Total, November to October.	10 a. m.	71	63	64	4.405	61	4.965

[a] First period. [b] Second period. [c] Third period. [d] Fourth period.

Evaporation at Kingsburg Bridge, King River—Continued.

TABLE No. 9.—NOVEMBER 1, 1883, TO OCTOBER 31, 1884.

Date.	Time of day.	Temperature of air.	Pan in river.			Pan in air.	
			Temperature of water in river.	Temperature of water in pan.	Evaporation (depth in feet).	Temperature of water in pan.	Evaporation (depth in feet).
1883.							
November	10 a. m	59	55	54	0.170	52	0.140
December	10 a. m	49	48	47	.080	44	.065
1884.							
January	9 a. m	47	48	48	.105	44	.075
February	9 a. m	52	52	52	.050	49	.060
March	9 a. m	61	56	57	.090	57	.105
April	9 a. m	67	60	61	.160	61	.180
May	9 a. m	76	59	61	.320	69	.400
June	9 a. m	77	57	60	.295	61	.505
July	9 a. m	83	61	63	.380	73	.670
August	9 a. m	78	64	66	.370	69	.670
September	9 a. m	75	63	63	.320	64	.520
October	9 a. m	68	62	63	.350	60	.310
November to January[a]					.355		.280
February to April[b]	9 a. m	60	56	57	.300	56	.345
May to July[c]	9 a. m	79	59	61	.995	68	1.575
August to October[d]	9 a. m	74	63	64	1.040	64	1.500
Total, November to October					2.690		3.700

[a] First period. [b] Second period. [c] Third period. [d] Fourth period.

Evaporation at Kingsburg Bridge, King River—Continued.

TABLE NO. 10.—NOVEMBER 1, 1884, TO OCTOBER 31, 1885.

Date.	Time of day.	Temperature of air.	Pan in river.			Pan in air.	
			Temperature of water in river.	Temperature of water in pan.	Evaporation (depth in feet).	Temperature of water in pan.	Evaporation (depth in feet).
1884.							
November	9 a. m.	58	58	57	0.200	55	0.120
December	9 a. m.	50	48	47	.180	48	.140
1885.							
January	9 a. m.	48	50	49	.010	47	.010
February	9 a. m.	54	53	53	.140	51	.130
March	9 a. m.	65	60	60	.240	59	.220
April	9 a. m.	68	62	63	.160	63	.270
May	9 a. m.	75	63	65	.340	68	.660
June	9 a. m.	77	65	68	.660	71	.810
July	9 a. m.	84	72	74	.710	74	.900
August	9 a. m.	86	72	72	.930	72	.930
September	9 a. m.	79	74	74	.640	71	.660
October	9 a. m.	71	67	66	.470	63	.360
November to January.[a]	9 a. m.	52	52	51	.390	50	.270
February to April[b]	9 a. m.	62	58	60	.540	58	.620
May to July[c]	9 a. m.	79	67	69	1.710	71	2.370
August to October.[d]	9 a. m.	79	71	71	2.040	69	1.950
Total, November to October.	9 a. m.	63	62	63	4.680	62	5.210

[a] First period. [b] Second period. [c] Third period. [d] Fourth period.

Evaporation at Kingsburg Bridge, King River—Continued.

TABLE NO. 11.—NOVEMBER 1, 1881, TO OCTOBER 31, 1885.

[Average for four years.]

Date.	Pan in river.			Pan in air.		
	Evaporation (depth in feet).	Evaporation per 24 hours (depth in feet).	Evaporation in cubic feet per second per square mile.	Evaporation (depth in feet).	Evaporation per 24 hours (depth in feet).	Evaporation in cubic feet per second per square mile.
November	0.176	0.0059	1.89	0.174	0.0058	1.87
December	.099	.0032	1.03	.104	.0034	1.08
January	.066	.0021	.69	.081	.0026	.84
February	.101	.0036	1.16	.091	.0033	1.05
March	.204	.0066	2.12	.225	.0073	2.34
April	.213	.0071	2.29	.286	.0095	3.08
May	.281	.0091	2.93	.551	.0178	5.74
June	.483	.0161	5.20	.776	.0259	8.35
July	.628	.0203	6.54	.904	.0292	9.41
August	.721	.0233	7.51	.861	.0278	8.96
September	.541	.0180	5.82	.615	.0205	6.62
October	.339	.0109	3.53	.289	.0093	3.01
November to January [a]	.341	.0037	1.20	.359	.0039	1.26
February to April [b]	.518	.0058	1.88	.603	.0068	2.19
May to July [c]	1.391	.0151	4.88	2.231	.0243	7.83
August to October [d]	1.601	.0174	5.61	1.765	.0192	6.19
Total November to October	3.851	.0106	3.40	4.958	.0136	4.38

[a] First period. [b] Second period. [c] Third period. [d] Fourth period.

CLEAR LAKE, LAKEPORT, CAL.

Evaporation records have been kept by the United States Geological Survey at Lakeport, Cal., on Clear Lake, since February 1, 1901. The evaporation pan is 3 feet square and 1.5 feet deep, and is floated on a triangular raft anchored in a cove where it is not exposed to the full force of the wind. Evaporation observations were begun on the

land at the same point September 15, 1901. Capt. D. C. Rumsey is the observer. The following table gives the evaporation by months:

Evaporation record of Clear Lake, Lakeport, Cal.

1901.	Lake.	Land.	1902.	Lake.	Land.
January	[a] 0.85	.....	January	0.85	0.85
February	.95	.....	February	.25	.30
March	2.40	.....	March	1.60	1.55
April	3.05	.....	April	2.60	2.35
May	3.70	.....	May	4.00	3.70
June	3.95	.....	June	4.65	5.15
July	5.15	.....	July	6.65	7.40
August	5.00	.....	August	4.40	4.95
September	3.35	[b] 1.60	September	4.10	4.40
October	2.30	2.45	October	1.95	1.85
November	.85	1.05	November	.45	.45
December	1.30	.95	December	.40	.45
Total for period of observations.	32.85	6.05	Total for period of observations.	31.90	33.40

[a] Estimated. [b] September 15-29 only.

DISCHARGE TABLES.

The following tables, showing measurements of the discharge of California streams, are arranged alphabetically under the names of the streams considered.

AGUILAR CREEK.

Discharge measurement of Aguilar Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Aug. —, 1899	G. F. Wright	.12	Santa Barbara County.

ALAMEDA CREEK.

Alameda Creek, in Alameda County, Cal., flows westerly into San Francisco Bay. The stream passes through narrows at Niles, where a weir dam known as the Niles dam is situated, and below this point spreads over certain absorbent gravel beds, at the lower end of which wells supplying considerable volumes of water are located. In the crest of the Niles dam is a rectangular weir opening. The length of this weir can be adjusted by inserting flash boards or planks. When the water reaches high stages it fills the rectangular weir opening

and flows over the top of the walls of the dam on the side, so that the large flood measurements that have been computed contain considerable elements of error. The measurements of smaller volumes, however, are doubtless more accurate. The Spring Valley Water Company, of San Francisco, has a pumping station which is supplied from an intake above the Niles dam, so that the amount of water pumped, as given in the following tables, should be added to the amount of water passing over the weir, in order to get total discharge.

During a term of years the Spring Valley Water Company kept observations at this weir dam of the height of water on the weir and the length of weir, and also of the amount of water pumped. These data were presented as Exhibit 11 in a certain suit entitled "Clough *v.* Crystal Springs Water Company of San Francisco," involving water rights to Alameda Creek, tried in the Alameda County superior court in the fall of 1901.

The record is not entirely complete, but the available data were assembled and computations of discharge were made by this office, and average monthly flow is given in the following tables. In some instances uncertainty exists as to the proper length of weir. This matter has been taken up, however, with the Spring Valley Water Company, and all corrections have been made for which the data are available. While the record is not considered perfect, it is the best obtainable, and in view of the extent of the data it is deemed to be worthy of publication.

Discharge measurements of Alameda Creek, Alameda County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Dec. 18, 1896	W. W. Brier	38.68	Niles dam.
Dec. 19, 1896	do	32.49	Do.
Dec. 20, 1896	do	30.94	Do.
Jan. 11, 1897	do	63.44	Do.
Jan. 12, 1897	do	57.25	Do.
Jan. 18, 1897	do	51.06	Do.
Dec. 18, 1896	do	7.74	3 miles below Niles.
Dec. 19, 1896	do	6.19	Do.
Dec. 20, 1896	do	.77	Do.
Jan. 11, 1897	do	44.87	Do.
Jan. 12, 1897	do	40.23	Do.
Jan. 18, 1897	do	34.04	Do.

Estimated monthly discharge of Alameda Creek at Niles dam.

Month.	Discharge over weir.			Quantity of water pumped.
	Maximum.	Minimum.	Mean.	
1889.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
January	.....	.....	.....	12
February	.....	.....	.....	11
March	.....	.....	.....	8
April	.....	.....	.....	13
May	.....	.....	.....	13
June	.....	.....	.....	12
July	.....	.....	.....	11
August	.....	.....	.....	7
September	.....	.....	.....	5
October	.....	.....	.....	7
November	.....	.....	.....	8
December	2,577	.....	996	4
The year	.....	.....	.....	9.25
1890.				
January	7,792	412	1,664	2
February	2,813	237	1,007	.....
March	1,353	324	646	.....
April	412	176	242	.....
May	253	82	144	.....
June	88	41	62	.....
July	47	22	31	7
August	22	16	20	13
September	38	16	17	12
October	28	16	17	12
November	22	16	19	12
December	293	31	49	10
The year	.....	.....	326.5	5.7

Estimated monthly discharge of Alameda Creek at Niles dam—Continued.

Month.	Discharge over weir.			Quantity of water pumped.
	Maximum.	Minimum.	Mean.	
1891.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
January	165	38	58	9
February	3,311	38	457	10
March	3,965	98	424	5
April	253	84	147	10
May	79	47	60	12
June	47	22	32	12
July	19	2	9	12
August	2	0	2	12
September				10
October				10
November				10
December	1,701	0	84	10
The year			[a] 159.1	10.17
1892.				
January	324	22	78	8
February	279	47	86	12
March	2,016	54	190	11
April	752	62	168	9
May	324	41	111	11
June	34	14	23	12
July	14	0	[b] 4	12
August				9
September				6
October				6
November	3,566	599	[c] 4,332	7
December	4,951	120	997	3
The year				8.8

[a] Eight months' mean.
[b] Mean of July 1 to 19, inclusive.
[c] Mean of November 28 to 30, inclusive.

Estimated monthly discharge of Alameda Creek at Niles dam—Continued.

Month.	Discharge over weir.			Quantity of water pumped.
	Maximum.	Minimum.	Mean.	
1893.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
January	2,016	120	437	6
February [a]	2,577	237	743	0
March				
April				
May				
June				2
July				12
August				12
September				9
October				8
November				8
December				7
The year			[b] 590	5.3
1894.				
January				3
February				
March				1
April				8
May				8
June				8
July				8
August				8
September				8
October				8
November				2
December 9 to 31	[c] 3,700	79	659	
The year				5.2

[a] No record for rest of year. [b] Two months mean. [c] No record prior to December 9.

Estimated monthly discharge of Alameda Creek at Niles dam—Continued.

Month.	Discharge over weir.			Quantity of water pumped.
	Maximum.	Minimum.	Mean.	
1895.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
January	4,521	200	1,221	.....
February	[a] 2,577	206	625	.....
March	224	125	170	.....
April	176	71	124	.....
May	224	54	92	.....
June	58	16	30	.....
July	16	3	10	[b] 4
August	3	1	1	12
September	[c] 2	2	2	12
October	47	0	8	12
November	14	3	7	12
December	25	6	9	12
The year	.....	.....	191.6	[d] 10.7
1896.				
January	2,936	6	534	6
February	306	75	118	.....
March	200	79	121	.....
April	2,577	79	336	.....
May	224	54	137	.....
June	54	16	29	7
July	16	2	5	12
August	2	1	1	12
September	4	1	1	12
October	23	0	3	12
November	25	4	8	10
December	872	12	81	8
The year	.....	.....	115	6.6

[a] Record missing February 15 to 28, inclusive.
[b] No record previous to July.
[c] Record missing September 16 to 30, inclusive.
[d] Six months mean.

Estimated monthly discharge of Alameda Creek at Niles dam—Continued.

Month	Discharge over weir.			Quantity of water pumped.
	Maximum.	Minimum.	Mean.	
1897.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
January	565	47	123	.....
February	2,577	224	837	.....
March	3,700	246	816	.....
April	639	98	227	.....
May	98	58	71	.....
June	54	19	25	.....
July	[a] 19	12	16	.....
August	.....	.....	.....	8
September	.....	.....	.....	8
October	.....	.....	.....	8
November	[b] 14	4	7	8
December	([c])	.....	.....	2
The year	.....	.....	.....	2.8
1898.				
January	.....	.....	.....	.....
February	.....	.....	.....	8
March	.....	.....	.....	9
April	.....	.....	.....	12
May	[d] 4	2	2	12
June	[e] 4	0	0	12
July	.....	.....	.....	9
August	.....	.....	.....	7
September	.....	.....	.....	8
October	([f])	.....	.....	10
November	0	0	0	11
December	2	0	0	11
The year	.....	.....	.....	9.1

[a] Mean of July 1 to 15, inclusive. No record for remainder of month.
[b] No record from July 16 to November 15, inclusive.
[c] No record from December 1, 1897, to May 22, 1898, inclusive.
[d] No record from December 1, 1897, to May 22, 1898, inclusive.
[e] June 18 to October 22, inclusive, water below crest.
[f] No length of weir given from October 23 to November 18, inclusive.

Estimated monthly discharge of Alameda Creek at Niles dam—Continued.

Month.	Discharge over weir.			Quantity of water pumped.
	Maximum.	Minimum.	Mean.	
1899.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
January	431	0	41	8
February	4	0	2	11
March[a]				6
April	200	21	54	10
May	19	6	12	11
June	8	2	4	12
July	1	0	1	12
August	0	0	0	12
September				11
October				10
November	[b] 338	8	47	6
December	565	14	101	7
The year				9.67
1900.				
January	3,700	41	297	5
February	47	25	34	12
March	306	25	112	7
April	71	25	35	12
May	31	7	17	12
June	[c] 6	1	4	12
July	1	0	0	12
August	1	0	0	12
September	[d] 17	0	4	10
October				12
November				[d] 9
December				
The year				[e] 10.45

[a] Record incomplete.
[b] August 17 to November 15, inclusive, water below crest.
[c] No record from June 17 to 24, inclusive.
[d] End of record.
[e] Eleven months mean.

ALDER CREEK.

Alder Creek is a tributary of the Santa Ana, in San Bernardino County. (See Santa Ana River, Alder Creek.)

ALISO CREEK.

Aliso Creek rises in the Fernando hills. It is normally dry at the points of measurement. During the night preceding the measurements there had been 0.65 inch of rain. At the point of first measurement it is 1.5 miles from the foothills. The measurements show the manner in which the creek sinks. Just below the point of second measurement the water all disappears.

Discharge measurements of Aliso Creek, San Fernando Valley.

Date.	Hydrographer.	Discharge.	Locality.
1901.		*Sec.-foot.*	
January 28	J. B. Lippincott	0.60	At Chatsworth road crossing.
Do	do	.32	2 miles below road crossing.

AMERICAN RIVER.

Discharge measurements of American River, Sacramento County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Sept. —, 1898	J. B. Lippincott	34.5	Folsom.
Aug. 3, 1901	C. W. Landis	619	Do.
Sept. 18, 1901	J. B. Lippincott	23	Eldorado flume at Riverton.
Sept. 16, 1899	S. G. Bennett	86	Main river, 1 mile above South Fork.
Sept. 14, 1900	do	235	Do.
Sept. 16, 1899	do	20	North Fork ditch, 2½ miles above Folsom.
Sept. 14, 1900	do	12	Do.
Dec. 28, 1878	State engineering department.	570	4 miles above Folsom.
July 14, 1879	do	4,000	Do.
Jan. 24, 1879	do	13,000	Sacramento, Twelfth street bridge.
Feb. 23, 1879	do	10,000	Near mouth.
May 21, 1879	do	10,000	Do.

Discharge measurements of South Fork of American River, Eldorado County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. 21, 1902	S. G. Bennett	100	Chillie Bar, 3 miles from Placerville.
		5	Big Canyon Creek at Chillie Bar.
Aug. 22, 1902	do	12	South Fork of Silver Creek, 200 feet above mouth.
Do	do	30	Main Silver Creek, 150 feet above junction of South Fork of Silver Creek.
Aug. 23, 1902	do	30	Eldorado ditch, 1 mile from Pacific post-office.
Sept. 18, 1899	S. G. Bennett	[a] 20	South Fork at iron road bridge near mouth.
Sept. 14, 1900	do	80.5	Do.
Do	do	35	South Fork, Natoma ditch.
Sept. 18, 1900	do	[a] 20	Do.
Aug. 2, 1901	do	36	South Fork, Natoma ditch near Salmon Falls.
Sept. 13, 1901	J. B. Lippincott	[b] 28	Silver Creek below mouth of Little Silver.
Sept. 14, 1901	do	[c] 40	Do.
Sept. 13, 1901	do	[c] 25	South Fork at Riverton.
Sept. 18, 1901	do	[d] 16	Do.
Aug. 22, 1902	S. G. Bennett	11	Do.
Sept. 19, 1901	J. B. Lippincott	69	South Fork at Mosquito Bridge.
Aug. 19, 1902	Chas. A. Miller	7.5	Branch of Natoma ditch, South Fork of American River.
Do	do	40	Natoma ditch.
Aug. 22, 1902	do	29	Natoma ditch near Salmon Falls.
Do	do	7.9	Nigger Hill ditch near Salmon Falls.
Aug. 21, 1902	do	87	Iron bridge near mouth.
Aug. 23, 1902	do	102	2 miles above iron bridge.

[a] Estimated.
[b] 4.30 p. m.
[c] 8 a. m.
[d] 11 a. m. Flume company is said to be diverting entire river at their intake above Riverton, but considerable water returns to the river from leaks in old flume.

Discharge measurements of North Fork of American River.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Aug. 25, 1902	S. G. Bennett	59	200 feet above Colfax, Iowa Hill road bridge.
Do	do	35	South Yuba Water Company's new power canal.
Aug. 21, 1902	Chas. A. Miller	204	Above junction with South Fork.
Aug. 23, 1902	do	145	1 mile above mouth of South Fork.
Aug. 27, 1902	do	121	Do.
Aug. 28, 1902	do	78	2½ miles from Auburn above mouth Middle Fork.
Aug. 26, 1902	do	14	North Fork Canal, second crossing of ditch from Folsom.

Discharge measurements of Middle Fork of American River.

Date.	Hydrographer	Discharge.	Locality.
		Sec.-ft.	
Aug. 26, 1902	S. G. Bennett	25	North Fork of Middle Fork, 300 feet above junction.
Do	do	11	North Fork of Middle Fork, mining ditch.
Do	do	18	300 feet above junction with Rubicon River.
Do	do	42	Rubicon River, 300 feet above junction with Middle Fork of American River.
Aug. 28, 1902	do	110	Middle Fork above mouth.

ARMAS CREEK.

Discharge measurements of Armas Creek, Santa Barbara County.

Date	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Aug. . 1889	G. F. Wright	0.08	

ARMITAS CREEK.

Discharge measurements of Armitas Creek, Santa Barbara County.

Date.	Hydrographer	Discharge.	Locality.
		Sec.-ft.	
Aug. . 1889	G. F. Wright	0.04	

ARROYO BURRO.

Discharge measurements of Arroyo Burro,[a] Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.23	
June 21, 1902	J. B. Lippincott	.0036	100 feet below Moore's north line.
June 17, 1900	J. Harrington	.03	San Roqui Creek, above tunnel.
Do	do	.03	San Roqui Creek, below tunnel.
May 2, 1900	do	.04	San Roqui Creek, station 6, opposite tunnel.
Do	do	.02	San Roqui Creek, station 8, opposite tunnel.
Do	do	.08	Tunnel of Pacific Improvement Co.
June 21, 1902	J. B. Lippincott	.009	San Roqui Creek, below tunnel.
Do	do	.25	Tunnel of Pacific Improvement Co.
Do	do	.011	San Roqui Creek at station 44, opposite tunnel.
Do	do	.0063	San Roqui Creek at station 65, opposite tunnel.

ARROYO CARNERO.

Discharge measurements of Arroyo Carnero, Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.08	

ARROYO GRANDE.

Discharge measurements of Arroyo Grande, San Luis Obispo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Nov. 20, 1897	W. W. Brier	7.80	Arroyo Grande.

ARROYO LEON.

Discharge measurements of Arroyo Leon, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Oct. 17, 1893	W. W. Brier	0.63	½ mile above Half Moon Bar.

[a] The upper mountainous portion of this stream is called the San Roqui and the lower part the Arroyo Burro.

ARROYO SECO.

This stream is a tributary of Los Angeles River, which it joins at the city of Los Angeles. Its basin is small, draining 21 square miles of the Sierra Madre. The river issues from the mountains on the west side of Pasadena Mesa, passes through an opening in a granite spur known as Devils Gate, and joins Los Angeles River at Los Angeles. Between the point where the water issues from the mountain and Devils Gate lies a broad river bottom 2 miles in length, composed of coarse material. In passing over this the water sinks rapidly, diminishing in volume of flood water from the mouth of the canyon to Devils Gate. It is believed that a large portion of the underflow from the gravels above Devils Gate passes to the east of Devils Gate and flows toward the San Gabriel Valley. (See also Pasadena Mesa.)

Discharge measurements of Arroyo Seco, at cable station terminal quarries, Los Angeles County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Nov. 21, 1900, 1.30 p. m	E. P. Dewey	81
Nov. 21, 1900, 2 p. m	do	100
Nov. 21, 1900, 3 p. m	do	144
Nov. 22, 1900, 11 a. m	do	85
Nov. 22, 1900, 2 p. m	do	99
Nov. 23, 1900	do	31
Nov. 24, 1900, 3 p. m	do	11.5
Nov. 26, 1900, 3.45 p. m	do	8.7
Dec. 1, 1900	W. B. Clapp	4.3
Dec. 6, 1900	do	1.4
Jan. 6, 1901	do	7
Jan. 7, 1901, 9.30 a. m	do	172
Jan. 7, 1901, 3.45 p. m	do	103
Jan. 8, 1901	do	28
Jan. 11, 1901	do	14
Jan. 14, 1901	do	7
Jan. 20, 1901	do	5
Jan. 21, 1901	do	11
Jan. 23, 1901	do	7
Jan. 28, 1901	do	32
Jan. 29, 1901	do	11
Feb. 1, 1899	W. B. Clapp	.24
Mar. 17, 1899	do	3.24
Mar. 18, 1899	do	1.77
Mar. 19, 1899	do	.93
Mar. 20, 1899	do	2.52

Discharge measurements of Arroyo Seco, etc.—Continued.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Mar. 21, 1899	W. B. Clapp	1.90
Mar. 22, 1899	do	1.64
Mar. 23, 1899	do	1.56
Mar. 26, 1899	do	2.20
Mar. 28, 1899	do	1.22
Apr. 2, 1899	do	.28
Apr. 12, 1899	do	.08
Jan. 10, 1899	E. P. Dewey	3.02
Jan. 11, 1899	do	1.90
Jan. 12, 1899	do	2
Do	do	2.06
Nov. 20, 1900	do	.23
Nov. 21, 1900, 11 a. m	do	32
Nov. 21, 1900, 12 m	do	35
Nov. 21, 1900 1 p. m	do	75
Feb. 4, 1901	W. B. Clapp	29
Feb. 5, 1901, 11 a. m	do	869
Feb. 5, 1901, 3 p. m	do	410
Feb. 6, 1901	do	200
Feb. 9, 1901	do	102
Feb. 11, 1901	do	102
Mar. 16, 1901	do	17
Apr. 29, 1901	do	1.6
May 10, 1901	do	5.3

Discharge measurements of Arroyo Seco near Devils Gate, Los Angeles County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
June 14, 1899	T. D. Allen	[a] 5.17
July 12, 1897	do	[a] 5.12
Aug. 9, 1897	do	[a] 4.63
Oct. 11, 1897	do	[a] 4.13
Nov. 8, 1897	do	[a] 4.16
May 31, 1899	do	[a] 3.17
July 10, 1899	W. B. Clapp	[a] 2.87
Sept. 17, 1900	do	[a] 3.55
Sept. 16, 1898	F. H. Olmsted	[a] 3.60
Oct. 12, 1898	J. B. Lippincott	[a] 3.44

[a] Devils Gate developments, including Richardson and Wilson tunnels.

Discharge measurements of Arroyo Seco, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Jan. 11, 1899	W. B. Clapp	4.17	Loughery dam site.
Oct. 13, 1898	J. B. Lippincott	.08	Painter pipe-line diversion.
Sept. 16, 1898	F. H. Olmsted	1.69	Sheep corral, total.
Oct. 21, 1898	J. B. Lippincott	1.48	Do.
May 29, 1899	W. B. Clapp	1.43	Do.
June 3, 1899	do	1.36	Do.
June 21, 1899	do	1.62	Do.
July 1, 1899	do	1.33	Do.
July 13, 1899	do	1.30	Do.
Sept. 19, 1900	W. W. Cockins, jr	1.94	Do.
Sept. 21, 1900	J. B. Lippincott	1.37	Do.
Feb. 6, 1901	S. G. Bennett	270	Avenue 26 bridge (flood measurement).

BEAR CREEK.

See Santa Ana, Bear Creek.

BEAMS DITCH.

See San Bernardino Valley, Beams ditch.

BEAR RIVER.

Discharge measurements of Bear River, Yuba County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Sept. 17, 1900	S. G. Bennett	11.7	Wagon bridge 1 mile south of Wheatland.
Dec. 16, 1878	State engineering department.	10	Wire bridge.
Sept. 6, 1879	do	15	Do.
Feb. 22, 1879	do	6,500	Do.
Sept. 6, 1879	do	15	Wheatland.
Oct. 20, 1879	do	12	1 mile below wire bridge.
Aug. 25, 1902	S. G. Bennett	16	Below waste from old mining ditch.
Do	do	33	Old mining ditch of South Yuba Water Company, one-fourth mile below head works.
Aug. 26, 1902	Charles A. Miller	28	Wooden flume of South Yuba Water Company, near Auburn.

Estimated monthly discharge of Bear River, Merced County, at base of foothills.[a]

[Drainage area, 166 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	0	0	0	0	0	0
December	0	0	0	0	0	0
1879.						
January	0	0	0	0	0	0
February	312	0	25	1,388	0.15	0.16
March	570	0	57	3,505	.34	.39
April	197	5	54	3,213	.33	.37
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	257	0	18	1,107	.11	.13
The year	570	0	13	9,213	.08	1.05
1880.						
January	217	0	25	1,537	.15	.17
February	700	0	61	3,509	.37	.40
March	85	10	31	1,906	.19	.22
April	2,080	25	321	19,101	1.93	2.15
May	47	0	23	1,414	.14	.16
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	421	0	115	7,071	.69	.80
The year	2,080	0	48	34,538	.29	3.90

[a] Authority, State engineering department.

Estimated monthly discharge of Bear River, etc.—Continued.

Month.	Discharge			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1881.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,920	20	169	10,391	1.02	1.18
February	1,423	47	214	11,885	1.29	1.34
March	197	13	48	2,951	.29	.33
April	20	0	6	357	.04	.04
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	1,920	0	36	25,584	.22	2.89
1882.[a]						
January	0	0	0	0	0	0
February			33	1,833	.20	.21
March			100	6,149	.60	.69
April			130	7,736	.78	.87
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October			17	1,045	.10	.12
November			25	1,488	.15	.17
December			17	1,045	.10	.12
The year			27	19,296	.16	2.18

[a] Run-off for 1882, 1883, and 1884, estimated from previous measurements or from run off of neighboring streams.

Estimated monthly discharge of Bear River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			66	4,058	.40	.46
February			33	1,833	.20	.21
March			170	10,453	1.02	1.18
April			100	5,950	.60	.67
May			50	3,074	.30	.35
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year			35	25,368	.21	2.87
1884.[a]						
January			17	1,045	.10	.12
February			660	37,964	3.98	4.29
March			910	55,954	5.48	6.32
April			660	39,273	3.98	4.44
May			330	20,291	1.99	2.29
June			170	10,116	1.02	1.14
July			66	4,058	.40	.46
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0

[a] Run-off for 1882, 1883, and 1884, estimated from previous measurements or from run-off of neighboring streams.

BIG ROCK CREEK.

Discharge measurements of Big Rock Creek, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec. feet.	
Jan. 4, 1898	J. B. Lippincott	5.27	Dam site above development tunnel.
Jan. 4, 1898	do	1.27	Diversion to tunnel.
Jan. 4, 1898	do	1.33	Developed in tunnel.
Jan. 4, 1898	do	.78	Cienega on Pallett tributary.

WILLIAMS RIVER.

Discharge measurement of Williams River, Yuma County, Ariz.

Date.	Hydrographer.	Discharge.	Locality.
		Sec. feet.	
Jan. 1, 1902	J. B. Lippincott	4	Mouth of river.
Oct. 28, 1902	E. T. Perkins	4	Do.

BLOOMINGTON FLUME, SAN BERNARDINO COUNTY.

See San Bernardino Valley.

BRISCOE CREEK, GLENN COUNTY.

See Stony Creek, Briscoe tributary.

BURNEY CREEK.

See Pit River, Burney tributary.

BUTANO CREEK.

Discharge measurement of Butano Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec. feet.	
Oct. 17, 1893	W. W. Brier	2.05	5 miles above junction with Pescadero Creek.

CACHE CREEK.[a]

This stream is the outlet of Clear Lake, in Lake County, Cal., and is described in Water-Supply Paper No. 51, p. 453.

On account of the great importance of Clear Lake as a storage reservoir, a gaging station was established at the wagon bridge across Cache Creek, one-half mile north of the town of Lower Lake, January 1, 1901. Gage rods were put in at this point and an observer was employed by Mr. P. N. Ashley, of Woodlands, for the Agricultural Department, about October, 1900, but no meter measurements were made.

In order to determine the evaporation from the surface of Clear Lake an evaporation pan and gage were placed in a cove near Lakeport in January, 1901, and the observations for evaporation were begun February 1 by Capt. D. C. Rumsey. The pan is not exposed to the full force of the wind, as the waves often run high.

Discharge measurements of Cache Creek, Lake County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Sept. 24, 1900	S. G. Bennett		3.8	Lower Lake Bridge.
Dec. 16, 1900	do	1.18	123	Do.
Jan. 25, 1901	do	3.60	675	Do.
Apr. 13, 1901	do	3.80	673	Do.
June 17, 1901	S. Matthews	2.85	333	Do.
July 15, 1901	do	2.45	236	Do.
Aug. 13, 1901	do	2.05	144	Do.
Sept. 4, 1901	J. R. Anderson	1.72	88	Do.
Oct. 5, 1901	do	1.45	34	Do.
Nov. 9, 1901	do	1.20	20	Do.
Nov. 29, 1901	do	1.60	69	Do.
Dec. 30, 1901	do	1.60	65	Do.
Jan. 29, 1902	do	1.60	70	Do.
Feb. 13, 1902	do	2.50	260	Do.
Mar. 3, 1902	do	6.50	1,151	Do.
Mar. 19, 1902	do	7.70	1,866	Do.
Apr. 5, 1902	do	6.5	1,397	Do.
Apr. 24, 1902	do	5.9	1,212	Do.
May 3, 1902	do	5.2	1,042	Do.
May 19, 1902	do	4.5	853	Do.
May 31, 1902	do	4.0	720	Do.
June 14, 1902	do	3.6	629	Do.
July 12, 1902	do	3.1	422	Do.

[a] For a detailed statement concerning the hydrography of Cache Creek, see Water-Supply Paper No. 45, by A. E. Chandler.

Discharge measurements of Cache Creek, Lake County—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
July 26, 1902	J. R. Anderson	2.8	345	Lower Lake Bridge.
Aug. 9, 1902	do	2.7	289	Do.
Aug. 22, 1902	do	2.5	246	Do.
Sept. 6, 1902	do	2.3	193	Do.
Sept. 20, 1902	do	2.2	156	Do.
Oct. 4, 1902	do	2.1	108	Do.
Oct. 20, 1902	do	2.0	83	Do.
Nov. 4, 1902	do	2.1	118	Do.
Nov. 19, 1902	do	2.8	245	Do.
Dec. 19, 1902	S. G. Bennett	2.8	300	Do.
June 24, 1900	do		196	Rumsey, Colusa County.
June 25, 1900	do		189	Do.
Sept. 23, 1900	do		3.8	Do.
Apr. 12, 1901	do		811	Do.
Apr. 15, 1901	do	3.4	720	Woodland Bridge, Yolo County.
May 8, 1902	do	4.4	1,276	Do.
Sept. 25, 1902	do	1.4	56	Do.

Estimated monthly discharge of Cache Creek at Lower Lake.

[Drainage area, 500 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	2,020	155	535	32,896	1.07	1.23
February	2,520	615	909	50,483	1.82	1.89
March	1,330	805	1,079	66,345	2.16	2.49
April	805	530	654	38,916	1.31	1.46
May	570	380	481	29,576	.96	1.10
June	415	255	327	19,458	.65	.72
July	255	155	199	12,236	.40	.46
August	155	86	114	7,010	.23	.26
September	86	40	55	3,273	.11	.12
October	50	16	31	1,906	.06	.07
November	62	16	26	1,547	.05	.06
December	74	40	62	3,812	.12	.14
The year	2,520	16	373	263,858	.75	10.00

Estimated monthly discharge of Cache Creek at Lower Lake—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1902.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	78	40	53	3,259	0.11	0.13
February	1,345	52	381	21,160	.76	.79
March	2,080	1,275	1,766	108,587	3.53	4.07
April	1,660	1,100	1,427	84,912	2.85	3.18
May	1,100	670	865	53,187	1.73	1.99
June	670	460	556	33,084	1.11	1.24
July	460	310	380	23,365	.76	.88
August	310	200	243	14,941	.49	.56
September	200	130	163	9,699	.33	.37
October	150	110	127	7,809	.25	.29
November	580	110	263	15,650	.53	.59
December	340	280	307	18,877	.61	.70
The year	2,080	40	544	394,530	1.09	14.79

CAJON CREEK.

Discharge measurements of Cajon Creek, San Bernardino County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
June 8, 1900	S. G. Bennett	1.37	Keenebrook station.

CALAVERAS RIVER.

Discharge measurements of Calaveras River, Calaveras County.

Date.	Hydrographer	Discharge.	Locality
		Sec.-feet.	
Sept. 6, 1899	S. G. Bennett	Dry	San Andreas, Jackson road.

Estimated monthly discharge of Calaveras River at Bellota.[a]

[Drainage area, 491 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November[b]	0	0	0	0
December[b]	0	0	0	0
1879.				
January	229	14,081	0.47	0.54
February	648	35,988	1.32	1.37
March	1,068	65,669	2.18	2.51
April	680	40,463	1.38	1.54
May	166	9,878	.34	.39
June[b]	98	5,831	.20	.22
July[b]	24	1,476	.05	.06
August[b]	0	0	0	0
September[b]	0	0	0	0
October[b]	0	0	0	0
November[b]	0	0	0	0
December[b]	295	18,139	.60	.69
The year[b]	267	191,525	.55	7.32
1880.[c]				
January	221	13,589	.45	.52
February	393	22,606	.80	.86
March	614	37,753	1.25	1.44
April	4,174	248,370	8.50	9.48
May	1,473	90,571	3.00	3.46
June	196	11,663	.40	.45
July	24	1,476	.05	.06
August	10	615	.02	.02
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	246	15,126	.50	.58
The year	613	441,769	1.25	16.87

[a] Authority, California State engineering department.

[b] For November and December, 1878, and from June, 1879, to October, 1884, estimated from run-off of neighboring stream.

[c] Estimated from run-off of neighboring stream.

Estimated monthly discharge of Calaveras River at Bellota—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1881.[a]	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,473	90,571	3.00	3.46
February	2,700	149,950	5.50	5.73
March	982	60,381	2.00	2.31
April	982	58,433	2.00	2.23
May	196	12,052	.40	.46
June	74	4,403	.15	.17
July	49	3,013	.10	.12
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	74	4,550	.15	.17
The year	544	383,353	1.11	14.65
1882.[a]				
January	344	21,152	.70	.81
February	442	24,547	.90	.94
March	1,719	105,697	3.50	4.04
April	1,719	102,288	3.50	3.90
May	2,946	181,142	6.00	6.92
June	246	14,638	.50	.56
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	98	6,026	.20	.23
November	147	8,747	.30	.33
December	147	9,039	.30	.35
The year	651	473,276	1.33	18.08

[a] Estimated from run-off of neighboring stream.

Estimated monthly discharge of Calaveras River at Bellota—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	491	30,190	1.00	1.15
February	393	21,826	.80	.83
March	737	45,316	1.50	1.73
April	982	58,433	2.00	2.23
May	491	30,190	1.00	1.15
June	196	11,663	.40	.45
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	74	4,550	.15	.17
November	24	1,428	.05	.06
December	49	3,013	.10	.12
The year	286	206,609	.58	7.89
1884.[a]				
January	196	12,052	.40	.46
February	2,455	141,213	5.00	5.39
March	2,946	181,142	6.00	6.92
April	2,455	146,083	5.00	5.58
May	491	30,190	1.00	1.15
June	491	29,217	1.00	1.12
July	196	12,052	.40	.46
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0

[a] Estimated from run-off of neighboring stream.

CALIENTE CREEK.[a]

Discharge measurements of Caliente Creek, Kern County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
May 1, 1895	J. B. Lippincott	23	1½ miles northwest of station.

[a] Stream usually dry in summer months.

Estimated monthly discharge of Caliente Creek, Kern County, at base of foothills.[a]

[Drainage area, 423 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
November	0	0	0	0
December	0	0	0	0
1879.				
January	34	2,091	0.08	0.09
February	59	3,277	.14	.15
March	30	1,845	.07	.08
April	106	6,307	.25	.28
May	76	4,673	.18	.21
June	25	1,488	.06	.07
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	110	6,545	.26	.29
December	212	13,035	.50	.58
The year	54	39,261	.13	1.75
1880.				
January	508	31,236	1.20	1.38
February	973	55,968	2.30	2.48
March	1,100	67,636	2.60	3.00
April	1,227	73,012	2.90	3.24
May	846	52,019	2.00	2.31
June	212	12,615	.50	.56
July	21	1,291	.05	.06
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	85	5,058	.20	.22
December	212	13,035	.50	.58
The year	432	311,870	1.02	13.83

[a] Estimated from run-off of neighboring streams. Authority, California State engineering department.

Estimated monthly discharge of Caliente Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1881.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	212	13,035	0.50	0.58
February	423	23,492	1.00	1.04
March	423	26,009	1.00	1.15
April	423	25,170	1.00	1.12
May	423	26,009	1.00	1.15
June	212	12,615	.50	.56
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	51	3,136	.12	.14
The year	181	129,466	.43	5.74
1882.				
January	51	3,136	.12	.14
February	63	3,499	.15	.16
March	212	13,035	.50	.58
April	212	12,615	.50	.56
May	42	2,582	.10	.12
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	63	3,749	.15	.17
December	63	3,874	.15	.17
The year	59	42,490	.14	1.90

Estimated monthly discharge of Caliente Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1883.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	63	3,874	0.15	0.17
February	63	3,499	.15	.16
March	338	20,783	.80	.92
April	212	12,615	.50	.56
May	169	10,391	.40	.46
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	42	2,582	.10	.12
November	42	2,499	.10	.11
December	63	3,874	.15	.17
The year	83	60,117	.20	2.67
1884.				
January	212	13,035	.50	.58
February	1,269	72,994	3.00	3.24
March	1,269	78,028	3.00	3.46
April	846	50,340	2.00	2.23
May	169	10,391	.40	.46
June	212	12,615	.50	.56
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0

CALLOWAY CANAL.

See Kern River, Calloway canal.

CAMP CARLTON DITCH, SAN BERNARDINO COUNTY.

See San Bernardino Valley, Camp Carlton ditch.

CANYADA DEL CORRAL.

Discharge measurement of Canyada del Corral Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.15	Santa Barbara County.

CANYADA LARES.

Discharge measurement of Canyada Lares Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.08	Santa Barbara County.

CANYADA REFUGIO.

Discharge measurement of Canyada Refugio Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.31	Santa Barbara County.

CANYADA VERDE.

Discharge measurement of Canyada Verde Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.08	Santa Barbara County.

CAPITAN CREEK.

Discharge measurement of Capitan (El) Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.23	Santa Barbara County.

CARPENTERIA CREEK.

Discharge measurement of Carpenteria Creek.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.08	Santa Barbara County, 1 mile above Placitas Road.
June 16, 1900	R. Moyer	.003	Do.

CARSON RIVER.

EAST FORK CARSON RIVER.

This branch of Carson River has its source in the high Sierra of California, and flows northward, crossing the Nevada-California boundary line and entering Carson Valley at Rodenbah's ranch, about 20 miles from Carson, a little east of south. There it turns to the northwest, and a short distance above the town of Genoa unites with the West Fork, forming Carson River. The drainage area above Rodenbah's is 414 square miles in extent, and is mapped on the Markleeville and Dardanelles atlas sheets of the United States Geological Survey. This gaging station was established by L. H. Taylor on October 17, 1900, at the place where measurements were made in the years 1890, 1891, and 1892. The rod was an inclined timber securely fastened to posts set in the right bank of the stream. The bench mark was on a basalt rock at the edge of the stream, 20 feet from the gage, and was at an elevation of 6.3 feet above gage datum. The channel at the station is straight and the banks are high. The stream bed is of cobbles and gravel, and is quite stable. Measurements are made from a cable and suspended car. On August 2, 1901, a loose rock dam was raised a short distance below the gaging station, which affected the velocity at the latter point. The dam was partly washed out by a freshet on December 4, 1901. On March 10, 1901, a new gage was established a short distance downstream from the original one, which had been destroyed. It consists of a vertical timber driven into the stream bed at the right bank and spiked to a cottonwood tree. A bench mark was also established on a large granite bowlder 20 feet south of the gage, under the cable from which the measurements are made. Its elevation is 8.10 feet above the datum of the gage.

Discharge measurements of East Fork Carson River, near Gardnerville, Nev.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 10, 1901	L. H. Taylor	4.00	459
Apr. 30, 1901	do	4.55	[a] 864
June 1, 1901	do	5.85	1,868
June 9, 1901	do	5.40	1,356
Sept. 29, 1901	do	3.70	[a] 127
Nov. 7, 1901	do	3.70	[a] 117
Dec. 19, 1901	do	3.40	156

[a] Approximate.

Estimated monthly discharge of East Fork Carson River, at Gardnerville (Rodenbah), Nev.

[Drainage area, 1,519 square miles.]

Month.	Mean discharge.	Month.	Mean discharge.
1890.	*Sec.-ft.*	1891—Continued.	*Sec.-ft.*
April	1,026	October	385
May	2,654	November	385
June	2,430	December	438
July	1,789	The year	619
August	597	1892.	
September	415	January	390
October	386	February	388
November	384	March	422
December	379	April	478
1891.		May	1,226
January	388	June	1,158
February	402	July	506
March	783	August	413
April	452	September	414
May	1,445	October	416
June	1,328	November	414
July	618	December	1,097
August	408	The year	610
September	388		

For further details of the flow of East and West forks of Carson River, see the Twelfth Annual Report of the United States Geological Survey, Pt. II, page 351.

WEST FORK, CARSON RIVER.

This stream rises on the eastern slope of the Sierra Nevada in California, immediately southeast of the source of Truckee River, and, flowing in a general northeast direction, crosses the State line into Nevada and joins the East Fork near Genoa, in Carson Valley. The drainage area is mapped on the Markleeville atlas sheet of the United States Geological Survey. This gaging station, established by L. H. Taylor on October 18, 1900, is about three-fourths of a mile above the post-office at Woodfords, near the point where measurements were made in 1890, 1891, and 1892. The gage at present in use is a vertical timber, but it is only temporary, the equipment of the station being incomplete. The channel at the station is straight, the banks are high and rocky, and the bed is of rock and gravel and not likely to shift. Measurements are made from a car suspended on a steel cable across the stream.

Discharge measurements of West Fork, Carson River, near Woodfords, Cal.

Date.	Hydrographer	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 8, 1901	L. H. Taylor	3.30	1.58
Apr. 28, 1901	do	3.95	[a]3.21
May 26, 1901	do	3.80	2.85
May 31, 1901	do	4.05	[a]3.50
June 13, 1901	do	3.75	2.74
Sept. 21, 1901	do	2.35	.31
Nov. 6, 1901	do	2.60	.68
Apr. 22, 1902	D. W. Hayes		182.50
May 13, 1902	C. V. Taylor		422.50
July 3, 1902	D. W. Hayes		157.60
July 30, 1902	do		46.70
Aug. 6, 1902	C. V. Taylor		53.00
Sept. 9, 1902	L. L. Richards		40.00

[a]Approximate.

Estimated monthly discharge of West Fork Carson River, at Woodfords, Cal.

[Drainage area, 70 square miles.]

Month.	Mean discharge.	Month.	Mean discharge.
1890.	*Sec.-ft.*	1891—Continued.	*Sec.-ft.*
April	284	May	534
May	657	June	338
June	614	July	130
July	380	August	65
August	135	September	41
September	75	October	48
October	67	November	43
November	49	December	47
December	53	The year	128
1891.		1892.	
January	52	January	45
February	48	February	46
March	61	March	65
April	127		

Discharge measurements in Carson River Basin.

Date.	Hydrographer.	Discharge.	Location.
		Sec. ft.	
Aug. 6, 1902	C. V. Taylor	0.72	Indian Creek and Harvey's ditch.
Do	do	1.18	Hawkins Creek, one-fourth mile above Hawkins's house.
Sept. 9, 1902	L. L. Richards	1.10	Do.
Aug. 6, 1902	C. V. Taylor	1.27	Petersons Creek, near old sawmill.
Sept. 9, 1902	L. L. Richards	.42	Petersons Creek, above Cohn's meadow.
Aug. 6, 1902	C. V. Taylor	2.84	Bruns Creek, mouth of canyon.
Sept. 9, 1902	L. L. Richards	3.48	Do.

CASCADE CREEK, TUOLUMNE COUNTY.

See Stanislaus River, Cascade Creek.

CHERRY CREEK, TUOLUMNE COUNTY.

See Tuolumne River, Cherry Creek.

CHINO CREEK, RIVERSIDE COUNTY.

See Santa Ana River, Chino Creek.

CHOWCHILLA CREEK.

Estimated monthly discharge of Chowchilla Creek at base of foothills.[a]

[Drainage area, 268 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	0	0	0	0	0	0
December	0	0	0	0	0	0
1879.						
January	140	0	8	492	0.03	0.03
February	1,000	0	56	3,110	.21	.22
March	760	0	63	3,874	.24	.28
April	300	11	48	2,856	.18	.20
May	140	0	14	861	.05	.06
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	192	0	12	738	.04	.04
The year	1,000	0	17	11,931	.06	.83
1880.						
January	18	0	5	307	.02	.02
February	1,500	0	167	9,606	.62	.67
March	91	11	19	1,168	.07	.08
April	6,380	0	1,266	75,332	4.72	5.26
May[b]			53	3,259	.20	.23
June[b]			27	1,607	.10	.11
July[b]	0	0	0	0	0	0
August[b]	0	0	0	0	0	0
September[b]	0	0	0	0	0	0
October[b]	0	0	0	0	0	0
November[b]	0	0	0	0	0	0
December[b]			201	12,359	.75	.86
The year			145	103,638	.54	7.23

[a] Authority, California State engineering department.
[b] Estimated from previous measurements, or from run-off of neighboring stream.

Estimated monthly discharge of Chowchilla Creek at base of foothills—Continued.

Month.	Discharge.			Total discharge.	Run-off	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1881.[a]	*Sec. feet.*	*Sec.-feet.*	*Sec. feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			295	18,139	1.10	1.27
February			375	20,826	1.40	1.46
March			83	5,103	.31	.36
April			11	655	.04	.04
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December			27	1,660	.10	.12
The year			66	46,383	.25	3.25
1882.						
January[a]			54	3,320	.20	.23
February	1,120	0	164	9,108	.61	.64
March	10,770	0	1,168	71,818	4.36	5.02
April[a]			268	15,947	1.00	1.12
May[a]			54	3,320	.20	.23
June[a]	0	0	0	0	0	0
July[a]	0	0	0	0	0	0
August[a]	0	0	0	0	0	0
September[a]	0	0	0	0	0	0
October[a]	0	0	0	0	0	0
November[a]			53	3,154	.20	.22
December[a]			27	1,660	.10	.12
The year			149	108,327	.56	7.58

[a] Estimated from previous measurements, or from run-off of neighboring stream.

Estimated monthly discharge of Chowchilla Creek at base of foothills—Continued.

Month.	Discharge.			Run-off.		
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			80	4,919	0.30	0.35
February			53	2,943	.20	.21
March			268	16,479	1.00	1.15
April			134	7,974	.50	.56
May			107	6,579	.40	.46
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year			54	38,894	.20	2.73
1884.[a]						
January			27	1,660	.10	.12
February			1,340	77,078	5.00	5.39
March			1,608	98,872	6.00	6.92
April			1,072	63,788	4.00	4.46
May			804	49,436	3.00	3.46
June			804	47,841	3.00	3.35
July			268	16,479	1.00	1.15
August			27	1,660	.10	.12
September			0	0	0	0
October			0	0	0	0

[a] Estimated from previous measurements, or from run-off of neighboring stream.

CITY CREEK.

Discharge measurements of City Creek at mouth of canyon, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
June 11, 1898	J. B. Lippincott	3.03
Sept. 9, 1898	do	.07
Mar. 25, 1899	S. G. Bennett	8.80
Aug. 25, 1899	do	.17
July 12, 1900	do	.16
Oct. 1, 1900	W. W. Cockins, jr	.21
Apr. 7, 1902	S. G. Bennett	12.5
Sept. 1, 1902	W. B. Clapp	.2

NOTE. For measurements of sundry small canals from City Creek in San Bernardino Valley see Santa Ana River near Cotton. Detailed descriptions given in Water-Supply Paper No. 59.

COLD SPRING CANYON.

Discharge measurements of Cold Spring Canyon, Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. 13, 1897	Montecito Water Co	0.66	City tunnel.
Do	do	.08	Creek at falls.
Sept. 6, 1897	do	.31	City tunnel.
Do	do	.06	Creek at falls.
Sept. 12, 1897	do	.31	City tunnel.
Do	do	.09	Creek at falls.
Oct. 2, 1897	do	.28	City tunnel.
Do	do	.09	Creek at falls.
Dec. 8, 1897	do	.22	City tunnel.
Do	do	.09	Creek at falls.
Jan. 26, 1898	do	.22	City tunnel.
Do	do	.11	Creek at falls.
June 11, 1900	R. Moyer	.02	City tunnel, station 29+97.
Do	do	.04	City tunnel, 100 feet from head, station 29+27.
Apr. 19, 1898	Montecito Water Co	.22	City tunnel.
June 10, 1900	J. B. Lippincott	.41	City tunnel at Portal.
Do	do	Dry.	Creek at falls.
Mar. 22, 1896	Montecito Water Co	.06	City tunnel.
Do	do	Dry.	Creek at falls.
Aug. [illegible], 1889	G. F. Wright	.23	

COLDWATER CREEK.

Discharge measurements of Coldwater Creek, Riverside County, one-fifth mile above dam.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Jan. 4, 1899	F. Rolfe	0.82
Jan. 18, 1899	do	1.43
Jan. 27, 1899	do	.84
Feb. 3, 1899	do	.99
Feb. 11, 1899	do	.97
Feb. 18, 1899	do	.78
Feb. 24, 1899	do	.94
Mar. 1, 1899	do	.92
Mar. 12, 1899	do	.71
Mar. 17, 1899	do	1.60
Mar. 25, 1899	do	1.18
Mar. 31, 1899	do	.84
Apr. 14, 1899	do	.68
Apr. 15, 1899	do	.62
Apr. 21, 1899	do	.26
Apr. 26, 1899	do	.38
May 5, 1899	do	.37
May 13, 1899	do	.21
May 17, 1899	do	.21
May 29, 1899	do	.27
May 31, 1899	do	.38
Do	do	.30
June 5, 1899	do	.30
June 7, 1899	do	.22

COLORADO RIVER.

Discharge measurements of Colorado River.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Aug. 18, 1875	U. S. Engineers		18,410	Stones Ferry.
Aug. 20, 1875	do		11,610	Camp Mohave.
Mar. 15, 1876	do		7,659	Yuma.
Jan. 17, 1895	J. B. Lippincott	20.3	9,737	Do.
Apr. 18, 1895	do	20.2	21,094	Do.
July 10, 1895	do	21.2	45,533	Do.
May 20, 1896	do	22.2	57,903	Do.

Discharge measurements of Colorado River—Continued.

1901	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Aug. 18, 1901	H. G. Heisler	20.71	18,683	Yuma.
Jan. 9, 1902	J. B. Lippincott	17.2	3,637	Do.
Feb. 20, 1902	S. G. Bennett	17.15	3,939	Do.
May 30, 1902	do	23	38,400	Do.
July 9, 1902	do	20.52	14,799	Do.
July 7, 1902	W. W. Follett	21.06	18,350	Do.
Oct. 11, 1902	S. G. Bennett	18.5	6,030	Do.
Oct. 14, 1902	R. P. H. Laney	17.9	4,798	Do.
Oct. 17, 1902	do	17.5	3,559	Do.
Oct. 21, 1902	do	17.6	4,203	Do.
Oct. 24, 1902	do	17.5	3,547	Do.
Nov. 12, 1902	S. G. Bennett	17.4	3,614	Do.
Nov. 13, 1902	do	17.5	3,865	Do.
Nov. 15, 1902	W. D. Smith	18.55	5,276	Do.
Nov. 18, 1902	do	18.05	4,213	Do.
Nov. 20, 1902	do	18	4,368	Do.
Nov. 22, 1902	do	18.10	4,600	Do.
Nov. 24, 1902	do	18.45	5,500	Do.
Nov. 26, 1902	do	18.40	4,979	Do.
Nov. 28, 1902	do	18.50	5,544	Do.
Dec. 1, 1902	do	20	12,596	Do.
Dec. 3, 1902	do	19.25	7,862	Do.
Dec. 5, 1902	do	18.85	6,347	Do.
Dec. 8, 1902	do	18.3	4,825	Do.
Dec. 10, 1902	do	18.2	5,081	Do.
Dec. 12, 1902	do	18	4,669	Do.
Dec. 15, 1902	do	17.65	3,818	Do.
Dec. 16, 1902	do	17.5	3,589	Do.
Dec. 18, 1902	do	18.3	5,361	Do.
Dec. 19, 1902	do	18.05	4,607	Do.
Dec. 20, 1902	do	18.05	5,237	Do.
Dec. 22, 1902	do	17.7	4,698	Do.
Dec. 24, 1902	do	18	4,863	Do.
Dec. 26, 1902	do	18.1	5,356	Do.
Dec. 27, 1902	do	18.3	5,497	Do.
Dec. 29, 1902	do	18	4,588	Do.
Dec. 31, 1902	do	17.7	4,176	Do.

Estimated monthly discharge of Colorado River at Yuma.

[Drainage area, 225,049 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1902.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	4,520	3,230	3,727	229,164	0.017	0.020
February	4,720	3,300	3,955	219,650	.018	.019
March	5,340	4,340	4,903	301,474	.022	.025
April	11,400	4,340	6,179	367,676	.027	.030
May	59,200	11,400	35,961	2,211,156	.160	.184
June	56,200	29,000	42,520	2,530,115	.189	.211
July	27,000	5,130	12,527	770,255	.056	.065
August	5,560	3,230	4,183	257,203	.019	.022
September	8,360	3,050	3,819	227,246	.017	.019
October	6,600	3,140	4,299	264,335	.019	.022
November	5,540	3,140	4,187	249,144	.019	.021
December	12,600	3,590	5,412	332,771	.025	.028
The year	59,200	3,050	10,973	7,960,189	.049	.666

Discharge measurements of Colorado River at Bulls Head Canyon.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Dec. 5, 1902	J. T. Whistler	3	5,786
Dec. 10, 1902	L. M. Barnes	2.65	4,051
Dec. 13, 1902	do	2.45	3,222
Dec. 17, 1902	do	2.95	4,138
Dec. 20, 1902	do	3.50	4,792
Dec. 24, 1902	do	3.23	4,939
Dec. 29, 1902	do	2.45	3,366
Dec. 31, 1902	do	2.20	2,913

COLTON CITY AND COLTON TERRACE, SAN BERNARDINO COUNTY.

See San Bernardino Valley.

CONVICT CREEK.

See Owens River, Convict Creek.

COSUMNES RIVER.

Discharge measurements of Cosumnes River, Eldorado County.

Date	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Sept. 16, 1899	S. G. Bennett	2	Bridge near Latrobe, Jackson road.
Do	do	2	Ditch on south side of Latrobe, Jackson road.
Sept. 12, 1900	do	1.7	Bridge near Latrobe, Jackson road.
Do	do	3.7	Ditch on south side.

Estimated monthly discharge of Cosumnes River at Live Oak Suspension Bridge, Sacramento County.[a]

[Drainage area, 580 square miles.]

Month.	Mean discharge	Total discharge.	Run-off.	
			Per square mile	Depth.
1878.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	29	1,726	0.05	0.06
December	29	1,783	.05	.06
1879.				
January	290	17,831	.50	.58
February	1,218	67,644	2.10	2.19
March	1,740	106,988	3	3.46
April	3,132	186,367	5.40	6.03
May	3,248	199,712	5.60	6.46
June	3,480	207,074	6	6.69
July	422	25,948	.73	.84
August	116	7,133	.20	.23
September	23	1,369	.04	.04
October	17	1,045	.03	.03
November	52	3,094	.09	.10
December	406	24,964	.70	.81
The year	1,179	849,169	2.03	27.46

[a] Authority: California State engineering department. Estimated from run-off of neighboring drainage basins.

Estimated monthly discharge of Cosumnes River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1880.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	232	14,265	0.40	0.46
February	441	25,367	.76	.82
March	696	42,795	1.20	1.38
April	4,582	272,648	7.90	8.81
May	5,104	313,833	8.80	10.15
June	6,090	362,380	10.50	11.71
July	2,726	167,615	4.70	5.42
August	348	21,398	.60	.69
September	29	1,726	.05	.06
October	17	1,045	.03	.03
November	12	714	.02	.02
December	290	17,831	.50	.58
The year	1,714	1,241,617	2.96	40.13
1881.				
January	1,624	99,856	2.80	3.23
February	3,074	170,721	5.30	5.52
March	1,102	67,759	1.90	2.19
April	3,190	189,818	5.50	6.14
May	3,074	189,013	5.30	6.11
June	1,218	72,476	2.10	2.34
July	174	10,699	.30	.35
August	87	5,349	.15	.17
September	87	5,177	.15	.17
October	58	3,566	.10	.12
November	174	10,354	.30	.33
December	522	32,097	.90	1.04
The year	1,199	856,885	2.07	27.71

Estimated monthly discharge of Cosumnes River, etc.—Continued.

Month	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1882.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	522	32,097	0.90	1.04
February	522	28,990	.90	.94
March	1,740	106,988	3	3.46
April	2,320	138,050	4	4.46
May	4,524	278,170	7.80	8.99
June	2,900	172,562	5	5.58
July	696	42,795	1.20	1.38
August	580	35,663	1	1.15
September	52	3,094	.09	.10
October	232	14,265	.40	.46
November	100	5,950	.17	.19
December	100	6,149	.17	.20
The year	1,191	864,773	2.05	27.95
1883.				
January	348	21,398	.60	.69
February	290	16,106	.50	.52
March	522	32,097	.90	1.04
April	1,740	103,537	3	3.35
May	3,480	213,977	6	6.92
June	2,320	138,050	4	4.46
July	580	35,663	1	1.15
August	232	14,265	.40	.46
September	87	5,177	.15	.17
October	87	5,349	.15	.17
November	116	6,902	.20	.22
December	116	7,133	.20	.23
The year	827	599,654	1.43	19.38

Estimated monthly discharge of Cosumnes River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1884.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	145	8,916	0.25	0.29
February	1,740	100,086	3	3.24
March	3,480	213,977	6	6.92
April	3,480	207,074	6	6.69
May	2,900	178,314	5	5.76
June	2,320	138,050	4	4.46
July	2,320	142,651	4	4.61
August	580	35,663	1	1.15
September	116	6,902	.20	.22
October	87	5,349	.15	.17

COW CREEK, TUOLUMNE COUNTY.

See Stanislaus River, Cow Creek.

CUCAMONGA CREEK.

Discharge measurements of Cucamonga Creek, San Bernardino County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. 26, 1898	F. H. Olmsted	1.04	Headworks in canyon.
July 11, 1900	S. G. Bennett	1.08	Do.
Oct. 7, 1901	do	2.06	Do.
Apr. 3, 1902	do	4.80	Do.

Following is a table showing measurements of cienagas and developed water at Red Hill:

Tabulation of measurements of cienagas and developments at Red Hill as indicated in miners' inches.

Fifty miners' inches to one second-foot.

		East side.								West side.										
Date.	Hydrographer.	Creek Div. box, 30-inch line.	Div. box 1, 16-inch line and Y tunnel, built in 1886.	China cienega	Lone Star Spring tunnel.	Y tunnel, built prior to 1886.	Cienaga below No. 1.	Total without Lone Star.	Total.	Spring northwest of tunnel No. 2 portal.	W. cienega, "D."	Picnic Spring, cienega C.	Artesian wells Nos. 1 and 2.	Tiburcio Spring.	Tunnel No. 2 on 90-acre.	China garden.	Stowell wells and tunnel above 90-acre tract.	Rain previous season	Total on 90-acre tract.	Grand total, Red Hills
Sept. 26, 1885	Wm M. Fitzhugh	225.36	.....	51.73	(2.02)	6.61 9.61 16.22	.....	293.31	295.33	56.47	45.27	(9.00)	.....	(1.00)	.....	.....	.....	10.81	111.74	406.07
Nov 30, 1886	J P Culver	261.43	64.67	11.46	2.02	.....	.....	337.56	339.57	9.50	5.70 97.80 .90 104.40	18.40	.....	2.16	.....	(a)	.....	21.83	134.46	474.03
July 24, 1887	F. Eaton	147.50	169.50	(10.00)	(2.00)	163.00	.....	327.00	329.00	13.67	31.90	10.00	(b)	(1.00)	.....	(16.76)	.....	14.50	73.33	402.33
July 13, 1888	J P. Culver	155.78	183.61	18.10	c13.59	138.62	46.43	357.49	371.08	3.14	38.89	5.38	15.14	1.59	d17.70	16.76	.....	17.76	98.60	469.68
July 13, 1889	E. T. Wright	184 58	163.57	13.27	9.78	136.23	48.36	361.42	371.20	3.94	40.53	17.33	15.14	1.81	54.02	(16.76)	.....	20.97	149.53	520.73
July 14, 1890	do	260.03	228.53	17.32	10.85	156.01	72.52	505.88	516.73	3.08	71.98	30.53	13.98	0.92	e73.82	(16.76)	.....	25.45	211.07	727.80
July 14, 1890	J P. Culver	266.82	238.04	18.50	11.25	165.55	72.49	523.36	534.61	3.14	81.78	31.47	14.29	2.38	75.42	(16.76)	.....	.....	225.24	759.85
June 29, 1893	E T. Wright	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.29	.....	.....	.....	.....	.....	19.82	.....	.....
July 14, 1893	do	.....	.....	.....	.....	152.42	.....	.....	.....	.....	.....	.....	.....	.....	36.45	.....	.....	.....	.....	.....
Sept. 15, 1894	do	f160.31	182.84	13.14	(8.00)	141.10	41.74	356.29	364.29	.....	.....	.....	.....	.....	.....	.....	.....	8.13	.....	.....
June 12, 1895[g]	do	198.53	154.87	21.00	(7.00)	(110.60)	(44.27)	374.40	381.40	.....	.....	.....	.....	.....	.....	.....	.....	20.98	.....	.....
June 14, 1896	N W. Stowell	.....	.....	.....	.....	.....	.....	.....	.....	0.00	22.00	1.00	23.00	.....	g18.00	.....	0.00	.....	64.00	352.55
Aug. 20, 1896	F. E. Trask	132 40	137 90	11.25	(7.00)	...	.....	281.55	288.55	.....	.....	.....	.....	.....	.....	.....	.....	8 11	.....	.....

Mar. 2, 1897	N. W Stowell																46.00			
Aug. 5 1897	do				9.42					0.00	20.00 7.00 27.00	(0.50)	h20.25	0.00	41.40	0.00			89.15	334 07
Aug. 10, 1897	F E Trask	104.90	120.10	10.50	i(9.42)			225.50	244.92	0.00								16.74		
Aug. 13, 1898	do	76.68	95.91	7.84	j47.00			180.43	227.43	0.00								8.24		
Aug. 14, 1898	N. W Stowell									0.00	k24.00	(0.50)	l13.00	0.00	26.00	0.00			63.50	290.93
Apr. 1, 1899	do	107.25	98.20					205.45										7.49		
Aug 21, 1899	E T. Wright	m91.58	80.95		n27.00 o75.00	56.17	24.78	172.53	n199.53 p247.53	0.00										
Aug 25 1899	E. T. Wright and F C. Finkle										3.13		2.68		61.80		92.40		67.61	267.14
Apr. 1, 1899	Newman and Finkle	107.25	98.20	(5.00)	q35.60	72.60		210.45	246.05	0.00	q15.49		7.90							
Feb. 3 and 5, 1900.	Newman, Trask, and Finkle	m97.06	77.22		17.06	54.88		174.28	191.34	0.00	3.91		1.45							
Feb. 11, 1900	Trask and Finkle										3.81	0.56	1.20		55.90		76.25		61.47	252.81

a China garden included in "D."
b Fall, 1897.
c Tunnel.
d Construction begun January, 1888.
e Length, 2,600 feet.
f 1 p. m.
g Caved in.
h August 4, well No. 2 cut.
i Exterior of tunnel begun, 11.
j Stowell.
k June 12, not pumped.
l July 24, not pumped.
m And China cienega.
n Flow.
o Pumped.
p When Lone Star Tunnel was pumped.
q March 15.

Discharge measurements of tributaries of Cucamonga Creek around Red Hills.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Sept. 9, 1898	O. J. Sutton	2.20	Springs.
Do	do	2.80	Tunnels.
Do	do	1.80	Artesian wells.
Total		6.80	
Aug. 29, 1899	S. G. Bennett	2.48	From Stowell wells to Ontario.
July 11, 1900	S. G. Bennett	4.03	East side.
Do	do	2.97	West side.
Do	do	2.13	San Antonio water, Haskell well.
Do	do	1.72	Sixteenth street wells.
Total from Red Hills.		10.85	

DALEY DITCH, SAN BERNARDINO COUNTY.

See San Bernardino Valley, Daley ditch.

DEER CREEK.

Estimated monthly discharge of Deer Creek, Tulare County, at base of foothills.[a]

[Drainage area, 110 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
November	0	0	0	0
December	0	0	0	0
1879.				
January	9	553	0.08	0.09
February	15	833	.14	.15
March	8	492	.07	.08
April	28	1,666	.25	.28
May	20	1,230	.18	.21
June	7	417	.06	.07
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	29	1,726	.26	.29
December	55	3,382	.50	.58
The year	14	10,299	.13	1.75

[a] Authority, California State engineering department. Estimated from run-off of neighboring streams.

Estimated monthly discharge of Deer Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1880.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	132	8,116	1.20	1.38
February	253	14,553	2.30	2.48
March	286	17,585	2.60	3.00
April	319	18,982	2.90	3.24
May	220	13,527	2.00	2.31
June	55	3,273	.50	.56
July	6	369	.05	.06
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	22	1,309	.20	.22
December	55	3,382	.50	.58
The year	112	81,096	1.02	13.83
1881.				
January	55	3,382	.50	.58
February	110	6,109	1.00	1.04
March	110	6,764	1.00	1.15
April	110	6,545	1.00	1.12
May	110	6,764	1.00	1.15
June	55	3,273	.50	.56
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	23	1,414	.21	.24
The year	48	34,251	.43	5.84

Estimated monthly discharge of Deer Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off	
			Per square mile	Depth
1882.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	23	1,414	0.21	0.24
February	17	944	.15	.16
March	55	3,382	.50	.58
April	55	3,273	.50	.56
May	11	676	.10	.12
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	11	676	.10	.12
November	17	1,012	.15	.17
December	6	369	.05	.06
The year	16	11,746	.15	2.01
1883.				
January	17	1,045	.15	.17
February	17	944	.15	.16
March	88	5,411	.80	.92
April	55	3,273	.50	.56
May	44	2,705	.40	.46
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	11	676	.10	.12
November	11	655	.10	.11
December	17	1,045	.15	.17
The year	22	15,754	.21	2.67

Estimated monthly discharge of Deer Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1884.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	55	3,382	0.50	0.58
February	330	18,982	3.00	3.24
March	330	20,291	3.00	3.46
April	220	13,091	2.00	2.23
May	44	2,705	.40	.46
June	55	3,273	.50	.56
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0

DINSMORE CREEK.

Discharge measurement of Dinsmore Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Aug. —, 1889	G. F. Wright	0.23

DOBBINS CREEK.

Discharge measurement of Dobbins Creek, Yuba County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Apr. 29, 1901	F. S. Hyde	[a] 224

[a] Estimated, at dam.

DOS PUEBLOS CREEK.

Discharge measurement of Dos Pueblos Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Aug. —, 1889	G. F. Wright	0.54

DRY OR JACKSON CREEK.

Estimated monthly discharge of Dry Creek, San Joaquin County, at base of foothills. [a]

[Drainage area, 283 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
November	0	0	0	0
December	0	0	0	0
1879.				
January	84	5,165	0.30	0.35
February	425	23,603	1.50	1.56
March	849	52,203	3.00	3.46
April	425	25,289	1.50	1.67
May	113	6,948	.40	.46
June	57	3,392	.20	.22
July	15	922	.05	.06
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	198	12,175	.70	.81
The year	181	129,697	.64	8.59
1880.				
January	127	7,809	.45	.52
February	140	8,053	.49	.53
March	354	21,767	1.25	1.44
April	2,264	134,717	8.00	8.93
May	879	54,048	3.11	3.59
June	113	6,724	.40	.45
July	15	922	.05	.06
August	6	369	.02	.02
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	142	8,731	.50	.58
The year	337	243,140	1.19	16.12

[a] Authority, California State engineering department. Estimated from run-off of neighboring streams.

Estimated monthly discharge of Dry Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1881.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	879	54,048	3.11	3.59
February	1,557	86,471	5.50	5.73
March	566	34,802	2.00	2.31
April	566	33,679	2.00	2.23
May	113	6,948	.40	.46
June	42	2,499	.15	.17
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	57	3,392	.20	.22
December	254	15,618	.90	1.04
The year	336	237,457	1.19	15.75
1882.				
January	254	15,618	.90	1.04
February	283	15,717	1.00	1.04
March	849	52,203	3.00	3.46
April	566	33,679	2.00	2.23
May	57	3,505	.20	.23
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	15	893	.05	.06
October	57	3,505	.20	.23
November	84	4,998	.30	.33
December	84	5,165	.30	.35
The year	187	135,283	.66	8.97

Estimated monthly discharge of Dry Creek, etc.—Continued.

Month	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1883.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	168	10,330	0.59	0.68
February	141	7,831	.50	.52
March	254	15,618	.90	1.04
April	283	16,840	1.00	1.12
May	168	10,330	.59	.68
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	15	922	.05	.06
November	0	0	0	0
December	15	922	.05	.06
The year	87	62,793	.31	4.16
1884.				
January	142	8,731	.50	.58
February	1,132	65,113	4.00	4.31
March	1,132	69,604	4.00	4.61
April	879	52,304	3.11	3.47
May	168	10,330	.59	.68
June	283	16,840	1.00	1.12
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0

EAST RIVERSIDE WATER COMPANY, SAN BERNARDINO COUNTY.

See San Bernardino Valley.

EATON CANYON.

Discharge measurements of Eaton Canyon, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Jan. 11, 1899	E. P. Dewey	0.50	Near falls.
Oct. 18, 1898	J. B. Lippincott	1.87	Water from large wells in Eaton Wash.
Do	do	.04	Around superintendent's house and barns.
Do	do	.10	San Gabriel water.
Do	do	.10	Dairy well.
Nov. 14, 1898	do	2.11	

ELEANOR CREEK.

See Tuolumne River, Eleanor Creek.

FALLS CREEK.

See Tuolumne River, Falls Creek.

FALL RIVER.

See Pit River, Fall River.

FEATHER RIVER.

Discharge measurements of Feather River, Butte County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Feb. 18, 1879	State engineering department.		21,000	Hennesseys.
May 13, 1879	do		15,000	Do.
Feb. 19, 1879	do		12,000	Burts Ferry.
Aug. 31, 1879	do		1,200	Do.
Nov. 12, 1879	do		2,700	Do.
Mar. 6, 1879	do		56,000	Marysville.
Sept. 1, 1879	do		1,200	Do.
July 16, 1879	do		1,900	Near mouth.
Aug. 27, 1879	do		1,200	Oroville.
Sept. 1, 1879	do		1,800	Below mouth of Yuba.
Sept 7, 1901	S. G. Bennett		34	West Branch of North Fork, Cherokee Pipe Crossing.
Sept. 18, 1900	do		1,123	Oroville Bridge.
Sept. 6, 1901	do		1,220	Do.

Discharge measurements of Feather River, Butte County—Continued.

Date	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Jan. 29, 1902	S. G. Bennett		1,960	Oroville Bridge.
Sept. 7, 1901	do		946	North Fork, Huffs Bar.
Mar. 1, 1902	do	8.7	15,228	Oroville Bridge.
May 7, 1902	do	8.75	15,476	Do.
Sept. 4, 1902	Chas. A. Miller	.96	1,385	Do.
Sept. 10, 1902	do	.92	1,390	Do.
Dec. 18, 1902	S. G. Bennett	3.65	3,298	Do.
Sept. 3, 1902	do		1	South Fork at Little Grass Valley.
Sept. 6, 1902	Chas. A. Miller		1	South Fork at bridge at Enterprise.
Do	do		216	South Fork at Bidwell Bar Bridge.
Do	do		30	South Fork Palermo Canal at Enterprise.
Sept. 4, 1902	S. G. Bennett		92	Middle Fork, below mouth of Nelson Creek.
Do	do		33	Middle Fork, Nelson Creek above mouth.
Do	do		28	Middle Fork, Spanish Creek at Pocket Bridge, lower end of American Valley.
Sept. 5, 1902	do		22	North Fork, Indian Creek at Indian Valley on Taylorsville road.
Do	do		607	North Fork at lower end Big Meadows.
Sept. 8, 1902	do		669	North Fork at Bidwell's sawmill.
Do	do		163	East Branch North Fork at Hamilton's bridge.
Sept. 9, 1902	do		64	Big Spring Branch of East Fork of North Fork at point 1 mile below boathouse.
Do	do		109	Dotta or Lower Big Spring Branch of North Fork at mouth.
Do	do		327	West Branch of North Fork near Prattville.
Sept. 7, 1902	do		27	Butte Valley Creek, North Fork, at Butte Valley post-office.
Sept. 9, 1902	Chas. A. Miller		595	North Fork, Huffs Bar.
Sept. 12, 1902	do		315	Big Bend Tunnel on North Fork, at portal of tunnel.
Sept. 9, 1902	do		27	West Fork of North Fork at Yankee Hill Bridge.

Estimated monthly discharge of Feather River at Oroville, Cal.

[Drainage area, 3,350 square miles.]

Month.	Discharge.			Total discharge	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1902.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	2,325	1,975	1,998	122,852	0.60	0.69
February	38,680	1,975	19,545	1,085,474	5.83	6.07
March	24,420	7,000	11,148	685,464	3.33	3.84
April	39,600	8,300	19,485	1,159,437	5.82	6.50
May	16,600	9,020	12,110	744,615	3.61	3.74
June	10,900	2,750	5,609	333,759	1.67	1.86
July	2,750	1,620	2,098	129,001	.63	.72
August	1,620	1,400	1,535	94,383	.46	.53
September	1,400	1,300	1,323	78,724	.40	.45
October	3,150	1,300	1,503	92,477	.45	.52
November	14,400	1,510	3,481	207,134	1.04	1.08
December	25,800	1,565	6,287	386,573	1.88	2.17
The year	39,600	1,300	7,177	5,119,893	2.14	28.57

FICAY CREEK.

Discharge measurement of Ficay Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge
		Sec.-feet.
Aug.—, 1889	G. F. Wright	0.31

FORT TEJON CREEK.

Discharge measurement of Fort Tejon Creek, in foothills, Kern County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Nov. 13, 1895	J. B. Lippincott	2.6
Feb. 3, 1896	do	3.5
June 4, 1896	do	1.1
Dec. 19, 1896	do	1.5

FRESNO CREEK.

Estimated monthly discharge of Fresno Creek, Madera County, at base of foothills.[a]

[Drainage area, 272 square miles.]

Month.	Maximum.	Minimum.	Mean.	Total discharge.	Run-off.	
					Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November[b]			0	0	0	0
December[b]			0	0	0	0
1879.						
January[c]	80	0	27	1,660	0.10	0.12
February[c]	117	66	80	4,443	29	.30
March[c]	202	66	118	7,256	.43	.50
April[c]	202	124	156	9,283	.57	.64
May[c]	102	66	79	4,858	.29	.33
June[c]	54	0	15	893	.06	.07
July[c]	0	0	0	0	0	0
August[c]	0	0	0	0	0	0
September[c]	0	0	0	0	0	0
October[c]	0	0	0	0	0	0
November[c]	0	0	0	0	0	0
December[c]			109	6,702	.40	.46
The year			49	35,095	.18	2.42
1880.[b]						
January			5	307	.02	.02
February			150	8,628	.55	.59
March			16	984	.06	.07
April			1,088	64,740	4.00	4.46
May			54	3,320	.20	.23
June			27	1,607	.10	.11
July			0	0	0	0
August			0	0	0	0
September			0	0	0	0
October			0	0	0	0
November			0	0	0	0
December			218	13,404	.80	.92
The year			130	92,990	.48	6.40

[a] Authority: California State engineering department.

[b] November and December, 1878, and from November, 1879, to October, 1884, inclusive, estimated from run off of neighboring streams.

[c] Measured.

Estimated monthly discharge of Fresno Creek, etc.—Continued.

Month.	Maximum.	Minimum.	Mean.	Total discharge.	Run-off. Per square mile.	Run-off. Depth.
1881.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			544	33,449	2.00	2.31
February			544	30,212	2.00	2.08
March			272	16,725	1.00	1.15
April			109	6,486	.40	.45
May			54	3,320	.20	.23
June			0	0	0	0
July			0	0	0	0
August			0	0	0	0
September			0	0	0	0
October			0	0	0	0
November			0	0	0	0
December			27	1,660	.10	.12
The year			129	91,852	.48	6.34
1882.[a]						
January			54	3,320	.20	.23
February			163	9,053	.60	.62
March			1,088	66,899	4.00	4.61
April			272	16,185	1.00	1.12
May			54	3,320	.20	.23
June			0	0	0	0
July			0	0	0	0
August			0	0	0	0
September			0	0	0	0
October			27	1,660	.10	.12
November			54	3,213	.20	.22
December			27	1,660	.10	.12
The year			145	105,310	.53	7.27

[a] November and December, 1878, and from November, 1879, to October, 1884, inclusive, estimated from run-off of neighboring streams.

Estimated monthly discharge of Fresno Creek, etc.—Continued.

Month.	Maximum.	Minimum.	Mean.	Total discharge.	Run-off.	
					Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			82	5,042	0.30	0.35
February			54	2,999	.20	.21
March			272	16,725	1.00	1.15
April			136	8,093	.50	.56
May			109	6,702	.40	.46
June			0	0	0	0
July			0	0	0	0
August			0	0	0	0
September			0	0	0	0
October			0	0	0	0
November			0	0	0	0
December			0	0	0	0
The year			54	39,561	.20	2.73
1884.[a]						
January			27	1,660	.10	.12
February			1,360	78,228	5.00	5.39
March			1,632	100,348	6.00	6.92
April			1,088	64,740	4.00	4.46
May			816	50,174	3.00	3.46
June			816	48,555	3.00	3.35
July			272	16,725	1.00	1.15
August			27	1,660	.10	.12
September			0	0	0	0
October			0	0	0	0

[a] November and December, 1878, and from November, 1879, to October, 1884, inclusive, estimated from run-off of neighboring streams.

GAGE CANAL.

See San Bernardino Valley, Gage canal.

GATO CREEK.

Gato Creek was measured by Charles J. Johansen for the Pacific Improvement Company, as given below. It was gaged a short distance above its junction with the Loma Abajo, and at the time of its measurement no water was being conveyed in the pipe line situated along this stream.

Discharge measurements of Gato Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Feb. 7, 1890	Charles J. Johansen	2.26	At mouth.
Feb. 14, 1890	do	2.37	Do.
Feb. 27, 1890	do	2.81	Do.
Mar. 2, 1890	do	2.05	Do.
Mar. 4, 1890	do	1.95	Do.
Mar. 6, 1890	do	1.85	Do.
Mar. 9, 1890	do	1.85	Do.
Mar. 11, 1890	do	1.65	Do.
Mar. 13, 1890	do	1.55	Do.
Mar. 15, 1890	do	1.45	Do.
Mar. 17, 1890	do	1.36	Do.
Mar. 21, 1890	do	1.45	Do.
Mar. 23, 1890	do	1.36	Do.
Mar. 25, 1890	do	1.27	Do.
Mar. 27, 1890	do	1.09	Do.
Mar. 29, 1890	do	1.09	Do.
Mar. 31, 1890	do	1.00	Do.
Apr. 2, 1890	do	1.00	Do.
Apr. 4, 1890	do	.92	Do.
Apr. 6, 1890	do	.92	Do.
Apr. 8, 1890	do	.92	Do.
Apr. 10, 1890	do	.83	Do.
Apr. 12, 1890	do	.83	Do.
Apr. 14, 1890	do	.76	Do.
Apr. 16, 1890	do	.76	Do.
Apr. 17, 1890	do	.68	Do.
Apr. 18, 1890	do	.76	Do.
Apr. 20, 1890	do	.76	Do.
Apr. 22, 1890	do	.76	Do.
Apr. 24, 1890	do	.68	Do.
Apr. 26, 1890	do	.68	Do.
Apr. 28, 1890	do	.60	Do.
Apr. 30, 1890	do	.68	Do.
May 2, 1890	do	.60	Do.

Discharge measurements of Gato Creek, Santa Barbara County—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
May 4, 1890	Charles J. Johansen	0.68	At mouth.
May 6, 1890	do	.68	Do.
May 8, 1890	do	.60	Do.
May 10, 1890	do	.53	Do.
May 12, 1890	do	.53	Do.
May 14, 1890	do	.46	Do.
May 16, 1890	do	.53	Do.
May 18, 1890	do	.46	Do.
May 20, 1890	do	.46	Do.
May 22, 1890	do	.59	Do.
May 24, 1890	do	.59	Do.
May 26, 1890	do	.58	Do.
May 28, 1890	do	.56	Do.
May 30, 1890	do	.56	Do.
June 1, 1890	do	.54	Do.
June 3, 1890	do	.49	Do.
June 5, 1890	do	.50	Do.
June 7, 1890	do	.49	Do.
June 9, 1890	do	.44	Do.
June 11, 1890	do	.50	Do.
June 13, 1890	do	.45	Do.
June 15, 1890	do	.50	Do.
June 17, 1890	do	.58	Do.
June 19, 1890	do	.50	Do.
June 21, 1890	do	.49	Do.
June 23, 1890	do	.44	Do.
June 25, 1890	do	.47	Do.
June 27, 1890	do	.45	Do.
June 29, 1890	do	.42	Do.
July 1, 1890	do	.44	Do.
July 3, 1890	do	.49	Do.
July 5, 1890	do	.34	Do.
July 7, 1890	do	.35	Do.
July 9, 1890	do	.32	Do.
July 11, 1890	do	.34	Do.
July 13, 1890	do	.34	Do.
July 15, 1890	do	.35	Do.
July 17, 1890	do	.33	Do.
July 19, 1890	do	.35	Do.
July 21, 1890	do	.27	Do.
July 23, 1890	do	.32	Do.

Discharge measurements of Gato Creek, Santa Barbara County—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 25, 1890	Charles J. Johansen	0.26	At mouth.
July 27, 1890	do	.32	Do.
July 29, 1890	do	.34	Do.
July 31, 1890	do	.34	Do.
Aug. 2, 1890	do	.34	Do.
Aug. 4, 1890	do	.34	Do.
Aug. 6, 1890	do	.29	Do.
Aug. 8, 1890	do	.27	Do.
Aug. 10, 1890	do	.32	Do.
Aug. 12, 1890	do	.35	Do.
Aug. 14, 1890	do	.30	Do.
Aug. 15, 1890	do	.27	Do.
Aug. 17, 1890	do	.26	Do.
Aug. 19, 1890	do	.28	Do.
Aug. 21, 1890	do	.35	Do.
Aug. 23, 1890	do	.28	Do.
Aug. 25, 1890	do	.30	Do.
Aug. 27, 1890	do	.30	Do.
Aug. 29, 1890	do	.28	Do.
Aug. 31, 1890	do	.26	Do.
Sept. 2, 1890	do	.22	Do.
Sept. 4, 1890	do	.22	Do.
Sept. 6, 1890	do	.26	Do.
Sept. 8, 1890	do	.26	Do.
Sept. 10, 1890	do	.26	Do.
Sept. 12, 1890	do	.26	Do.
Sept. 14, 1890	do	.22	Do.
Sept. 16, 1890	do	.22	Do.
Sept. 18, 1890	do	.26	Do.
Sept. 21, 1890	do	.30	Do.
Sept. 22, 1890	do	.22	Do.
Sept. 24, 1890	do	.22	Do.
Sept. 26, 1890	do	.22	Do.
Sept. 28, 1890	do	.37	Do.
Sept. 30, 1890	do	.60	Do.
Oct. 2, 1890	do	.42	Do.
Oct. 4, 1890	do	.35	Do.
Oct. 6, 1890	do	.30	Do.
Oct. 7, 1890	do	.30	Do.

GAZOO CREEK.

Discharge measurements of Gazoo Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Oct. 17, 1893	W. W. Brier	1.85	6 miles above mouth.

GORMAN CREEK.

See Piru Creek, Gorman Creek.

GREEN SPOT PIPE LINE.

See Santa Ana River, Green Spot pipe line.

GRINDSTONE CREEK.

See Stony Creek, Grindstone Creek.

GUBERNADOR CREEK.

Discharge measurement of Gubernador Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.58	

HAT CREEK.

See Pit River, Hat Creek.

HAWS AND TALMAGE DITCH.

See San Bernardino Valley, Haws and Talmage ditch.

HONEY LAKE.

Annual inflow estimated by State engineering department 200,000 acre-feet.

HOUSE CREEK.

See Tejon House Creek.

KAWEAH RIVER.

Discharge measurements of Kaweah River, Tulare County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Nov. 20, 1895	J. B. Lippincott	70	Headworks above upper large power canal.
Sept. 1, 1898	do	35	Do.
Sept. 6, 1899	S. G. Bennett	41	Do.
Sept. 3, 1900	do	78.5	Do.
Nov. 20, 1895	J. B. Lippincott	0	Iron bridge, wagon road.
Aug. 31, 1898	do	0	Southern Pacific branch railroad bridge.
Sept. 1, 1898	do	18	Iron bridge, wagon road.
Sept. 6, 1899	S. G. Bennett	33	Do.
Sept. 3, 1900	do	72	1,000 feet below iron bridge.
Do	do	15	Watunma Canal at head-gate.
Oct. 20, 1901	do	52	Iron bridge, 1,000 feet below.
Do	do	5	Watunma Canal.
Aug. 31, 1898	J. B. Lippincott	8.5	Kaweah irrigation and power ditch (Pogues lower ditch).
Sept. 6, 1899	S. G. Bennett	1.5	Do.
Sept. 3, 1900	do	8.1	Do.
Do	do	1	Myers ditch above Pogues upper ditch.
Aug. 31 1898	J. B. Lippincott	4.5	Pogues upper ditch.
Sept. 6, 1899	S. G. Bennett	4.9	Do.
Sept. 3, 1900	do	6.7	Do.
Sept. 1, 1898	J. B. Lippincott	.3	North Fork at mouth.
Sept. 6, 1899	S. G. Bennett	1.1	Do.
Sept. 1, 1898	J. B. Lippincott	0	South Fork canals.
Sept. 6, 1899	S. G. Bennett	.7	Do.
Sept. 25, 1902	E. T. Perkins	4.3	North Fork at lower end Davis ranch.
Do	do	.7	South Fork, 200 yards above bridge on road to Visalia.
Sept. 26, 1902	do	29	Middle Fork, ¾ mile above Sequoia National Park line.
Sept. 27, 1902	do	20	Middle Fork, 100 yards above junction with Marble Fork.
Do	do	4	Marble Fork, 100 yards above junction with Middle Fork.
Do	do	15	East Fork, ¼ mile above headworks Mount Whitney power plant.
Do	do	15.5	East Fork, 200 feet below headworks Mount Whitney power plant.
Sept. 28, 1902	do	11	East Fork, 100 yards below trail from Soldiers' Camp to Tar Gap.

Discharge measurements of Kaweah River, Tulare County—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Sept. 29, 1902	E. T. Perkins	1	South Fork, Horse Creek, at lower end Hackett Meadows.
Do	do	2	South Fork, lower end Sand Meadows.
Sept. 27, 1902	L. M. Lawson	33	¼ mile above iron bridge.
Sept. 29, 1902	do	9.8	South Fork, at Sequoia National Park line.
Sept. 30, 1902	do	31	Middle Fork, 3 miles above Three Rivers.
Sept. 10, 1902	R. McF. Doble	31	Middle Fork, ¼ mile inside Sequoia National Park line.
Sept. 12, 1902	do	18	East Fork (total flow), 1,600 feet from head of Mount Whitney Power Co. flume.

Estimated monthly discharge of Kaweah River at Wachumna Hill, Tulare County.[a]

[Drainage area, 619 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
November[b]	155	9,223	0.25	0.28
December[b]	155	9,531	.25	.29
1879.				
January[c]	248	15,249	.40	.46
February[c]	279	15,495	.45	.47
March[c]	402	24,718	.65	.75
April[c]	867	51,590	1.40	1.56
May[c]	774	47,591	1.25	1.44
June[c]	557	33,144	.90	1.00
July[c]	124	7,624	.20	.23
August[c]	31	1,906	.05	.06
September[c]	31	1,845	.05	.06
October[c]	62	3,812	.10	.12
November[c]	124	7,379	.20	.22
December[c]	279	17,155	.45	.52
The year	315	227,508	.51	6.89

[a] Authority, California State engineering department.
[b] Estimated in part from run-off of neighboring streams.
[c] Based in part on measurements and rod records near Three Rivers.

Estimated monthly discharge of Kaweah River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1880.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January [a]	248	15,249	0.40	0.46
February [a]	310	17,831	.50	.54
March [a]	464	28,530	.75	.86
April [a]	2,352	139,954	3.80	4.24
May [a]	2,786	171,304	4.50	5.19
June [a]	3,900	232,066	6.30	7.02
July [a]	743	45,685	1.20	1.38
August [b]	155	9,531	.25	.29
September [b]	99	5,891	.16	.18
October [b]	50	3,074	.08	.09
November [b]	74	4,403	.12	.13
December [b]	371	22,812	.60	.69
The year	963	696,330	1.56	21.07
1881.				
January [b]	526	32,342	.85	.98
February [b]	774	42,986	1.25	1.30
March [b]	619	38,061	1.00	1.15
April [b]	1,393	82,889	2.25	2.51
May [b]	1,238	76,122	2.00	2.31
June [b]	990	58,909	1.60	1.79
July [a]	371	22,812	.60	.69
August [a]	155	9,531	.25	.29
September [a]	43	2,559	.07	.08
October [a]	74	4,550	.12	.14
November [a]	124	7,379	.20	.22
December [a]	279	17,155	.45	.52
The year	549	395,295	.89	11.98

[a] Based in part on measurements and rod records near Three Rivers.
[b] Estimated in part from run-off of neighboring streams.

Estimated monthly discharge of Kaweah River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1882.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January [a]	155	9,531	0.25	0.29
February [a]	310	17,217	.50	.52
March [a]	464	28,530	.75	.86
April [a]	1,393	82,889	2.25	2.51
May [a]	2,228	136,994	3.60	4.15
June [a]	929	55,279	1.50	1.67
July [b]	743	45,685	1.20	1.38
August [b]	198	12,175	.32	.37
September [b]	93	5,534	.15	.17
October [b]	87	5,349	.14	.16
November [b]	124	7,379	.20	.22
December [b]	93	5,718	.15	.17
The year	568	412,280	.92	12.47
1883. [b]				
January	155	9,531	.25	.29
February	124	6,887	.20	.21
March	619	38,061	1.00	1.15
April	805	47,901	1.30	1.45
May	1,021	62,779	1.65	1.90
June	990	58,909	1.60	1.79
July	402	24,718	.65	.75
August	99	6,087	.16	.18
September	74	4,403	.12	.13
October	62	3,812	.10	.12
November	74	4,403	.12	.13
December	74	4,550	.12	.14
The year	375	272,041	.61	8.24

[a] Based in part on measurements and rod records near Three Rivers.
[b] Estimated in part from run-off of neighboring streams.

Estimated monthly discharge of Kaweah River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1884.[a]	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	248	15,249	0.40	0.46
February	2,177	125,222	3.52	3.80
March	2,290	140,807	3.70	4.27
April	1,548	92,112	2.50	2.79
May	2,847	175,055	4.60	5.30
June	4,271	254,142	6.90	7.69
July	3,497	215,022	5.65	6.51
August	990	60,873	1.60	1.84
September	495	29,455	.80	.89
October	248	15,249	.40	.46

[a] Estimated in part from run-off of neighboring streams.

KERN RIVER.

The gaging station on Kern River, established in 1893 by Mr. Walter Jones, chief engineer of the Kern County Land Company, is located at what is known as first point of measurement, 5 miles above Bakersfield. Meter measurements are taken once a week and an automatic gage records daily fluctuations of the river heights. Mr. A. K. Warren, the engineer in charge of this work for the Kern County Land Company, attends to the discharge measurements with much accuracy and precision, and furnishes the Survey with the final results.

Discharge measurements of Kern River, Kern County.

Date.	Hydrographer.	Discharge.	Locality.
		Second-feet.	
Feb. 10, 1897	J. B. Lippincott	314	Calloway Canal at second point of measurement.
July 17, 1898	F. H. Olmsted	5.3	Menache Meadows, Tulare County.
July 10, 1898	do	12.9	South Fork at mouth, Kern County.
July 11, 1898	do	17.9	Do.
July 13, 1898	do	10.1	South Fork, sec. 6-22-36, Kern County.
July 10, 1898	do	331	North Fork at mouth, Kern County.
June 29, 1896	J. B. Lippincott	3,004	First point of measurement.
Aug. 29, 1898	do	116	Do.

Discharge measurements of Kern River, Kern County—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Second-feet.	
Sept. 2, 1899	S. G. Bennett	99	First point of measurement.
Aug. 30, 1900	A. K. Warren	103	Do.
Oct. 7, 1902	L. M. Lawson	171	Do.
Feb. 10, 1897	J. B. Lippincott	322	Calloway Canal at first point of measurement.
Sept. 2, 1899	F. H. Olmsted	99.22	Kern River, first point of measurement.
June 19, 1900	do	1.32	Basin Creek, Rankin's ranch, Walker's basin.
June 20, 1900	do	14.18	South Fork of Kern River, 700 feet above junction.
Do	do	1,333.17	North Fork of Kern River, Hooper's Mill Bridge.
June 21, 1900	do	2.30	Bull Run Creek near mouth.
June 22, 1900	do	2.92	Tobias Creek near mouth.
Do	do	.18	Ant Creek at mouth; elevation, 3,200 feet.
Do	do	3.45	Salmon Creek at mouth.
Do	do	.32	Corral Creek near mouth.
June 23, 1900	do	5.82	South Needles Creek at Needles Peak; elevation, 4,550 feet.
Do	do	5.19	Clark Creek, Dry Meadows.
Do	do	5.74	Jackson Creek, Dry Meadows.
Do	do	5.07	Wade Creek, Dry Meadows.
June 24, 1900	do	4.26	North Needles Creek at Needles Peak.
Do	do	81	Little Kern River at junction with Kern River.
June 25, 1900	do	2.87	Tibbetts Creek, 1 mile above mouth.
Do	do	8.45	Harris Creek at mouth.
Do	do	4.87	One Mile Creek, 1 mile below Kern Lake.
Do	do	1,154.90	North Fork of Kern River, 3,000 feet above junction with Little Kern River.
Do	do	4.72	Whitney Creek at tunnel in divide.
June 27, 1900	do	39.11	Whitney Creek at Lava bridge.
Do	do	17.64	Creek south of Bald Mountain; elevation, 6,560 feet.
Do	do	939.60	North Fork of Kern River, 800 feet above Kern Lake.
June 28, 1900	do	3.67	South Fork of Kern River, Manache Meadows.
June 29, 1900	do	1.80	Tibbetts Creek; elevation, 8,300 feet.

Discharge measurements of Kern River, Kern County—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Second-feet.	
June 29, 1900	F. H. Olmsted	1.04	North Fork of Brush Creek; elevation, 5,800 feet.
Do	do	8.22	Brush Creek above North Fork; elevation, 5,600 feet.
June 30, 1900	do	825.25	North Fork of Kern River, 4,000 feet above junction with South Fork.
Do	do	4.05	Salmon Creek, Horse Meadows; elevation, 7,700 feet.
July 2, 1900	do	11.05	South Fork of Kern River, T. 25 S., R. 35 E., Mount Diablo meridian; elevation, 2,920 feet.
Do	do	2.38	Powers Ditch near head.
July 3, 1900	do	1.96	Neil's Ditch, Isabella.
Do	do	7.31	Hooper's Mill Ditch at gaging station on Kern River.
Oct. 4, 1902	E. T. Perkins	14	Little Kern 100 yards above junction.
Do	do	158	100 yards above junction with Little Kern.
Oct. 6, 1902	do	.5	Brown's upper ditch at road crossing to Hot Springs.
Do	do	7	Brown's main ditch at entrance to weir.
Do	do	1.5	Stafford & Neal ditch above Kernville.
Do	do	7.9	Brown's lower ditch above dairy.
Do	do	160	Power Company's diversion, Kernville.
Oct. 7, 1902	do	224	¼ mile above mouth of Salmon Creek.
Do	do	.5	Salmon Creek 50 yards above junction.
Do	do	127	Above gaging station, Kern River Power Co.
Oct. 8, 1902	do	188	½ mile above powerhouse, Kern River Power Co.
Do	do	236	Below Clear Creek.
Do	do	201	200 yards below junction South Fork.
Do	do	18	South Fork above junction.
Do	do	202	350 yards below bridge from Isabella to Kernville.
Do	do	9	Hooper ditch at bridge from Isabella to Kernville.
Do	do	.6	Lower Stafford ditch ¼ mile north of Staffords ranch.

Discharge measurements of Kern River, Kern County—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Second-feet.	
Oct. 8, 1902	E. T. Perkins	0.7	Lower Murphy ditch 75 yards above Weldon road crossing.
Do	do	7	South Fork at Weldon road crossing.
Oct. 7, 1902	L. M. Lawson	174	½ mile below mouth of canyon.
Do	do	14	Below intake of Power Company's tunnel.
Oct. 8, 1902	do	179	Democrat Springs 200 feet below hotel at springs.

Estimated monthly discharge of Kern River at Rio Bravo ranch, Kern County.[a]

[Drainage area, 2,345 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	----------	----------	400	23,802	0.17	0.19
December	----------	----------	350	21,521	.15	.17
1879.						
January	686	389	462	28,407	.20	.23
February	745	466	591	32,822	.25	.26
March	659	510	552	33,941	.24	.28
April	1,054	661	764	45,461	.33	.37
May	1,231	680	927	56,999	.40	.46
June	1,190	812	971	57,779	.41	.46
July	865	386	535	32,896	.23	.27
August	387	168	266	16,356	.11	.13
September	174	146	171	10,175	.07	.08
October	210	145	182	11,191	.08	.09
November	325	184	261	15,531	.11	.12
December	650	280	356	21,890	.15	.17
The year	1,231	145	503	363,448	.22	2.92

[a] Authority, California State engineering department, from November, 1878, to October, 1884, inclusive.

Estimated monthly discharge of Kern River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1880.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	410	315	354	21,767	0.15	0.17
February	380	315	370	21,283	.16	.17
March	385	349	389	23,919	.17	.20
April	3,320	395	1,557	92,648	.66	.74
May	3,560	1,615	2,659	163,496	1.13	1.30
June	4,070	2,740	3,317	197,375	1.41	1.57
July	3,140	1,550	2,196	135,027	.94	1.08
August	1,500	840	1,060	65,177	.45	.52
September	846	710	767	45,640	.33	.37
October	794	722	758	46,608	.32	.37
November	830	695	767	45,640	.33	.37
December	1,480	790	1,063	65,361	.45	.52
The year	4,070	315	1,271	923,941	.54	7.38
1881.						
January	1,640	950	1,078	66,284	.46	.53
February	2,970	1,430	1,773	98,467	.76	.79
March	2,100	1,400	1,570	96,536	.67	.77
April	2,612	2,100	2,288	136,145	.98	1.09
May	2,710	2,060	2,362	145,234	1.01	1.16
June	2,390	1,475	1,890	112,463	.81	.90
July	1,520	710	1,126	69,235	.48	.55
August	1,200	420	627	38,553	.27	.31
September	420	320	361	21,481	.15	.17
October	360	310	333	20,475	.14	.16
November	360	300	337	20,053	.14	.16
December	410	320	350	21,521	.15	.17
The year	2,970	300	1,175	846,447	.50	6.76

Estimated monthly discharge of Kern River, etc.—Continued.

Month	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1882.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet*	*Sec.-feet.*	*Inches.*
January	380	310	335	20,598	0.14	0.16
February	510	360	395	21,937	.17	.18
March	1,260	440	600	36,893	.26	.30
April	1,670	920	1,174	69,858	.50	.56
May	2,000	1,420	1,670	102,684	.71	.82
June	1,990	900	1,306	77,712	.56	.62
July	1,110	450	726	44,640	.31	.36
August			330	20,291	.14	.16
September			330	19,636	.14	.16
October			330	20,291	.14	.16
November [a]			280	16,661	.12	.13
December [a]			280	17,217	.12	.14
The year			646	468,418	.28	3.75
1883. [a]						
January			280	17,217	.12	.14
February			350	19,438	.15	.16
March			700	43,041	.30	.35
April			1,170	69,620	.50	.56
May			1,410	86,697	.60	.69
June			1,170	69,620	.50	.56
July			940	57,798	.40	.46
August			470	28,899	.20	.23
September			350	20,826	.15	.17
October			280	17,217	.12	.14
November			200	11,901	.09	.10
December			200	12,298	.09	.10
The year			627	454,572	.27	3.66

[a] Estimated from previous measurements and from run-off of neighboring steams.

Estimated monthly discharge of Kern River, etc.—Continued.

Month.	Discharge.			Run-off.		
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1884.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			350	21,521	0.15	0.17
February			470	27,035	.20	.22
March			940	57,798	.40	.46
April			1,980	117,818	.84	.94
May			5,860	360,317	2.50	2.88
June			9,380	558,149	4	4.46
July			5,860	360,317	2.50	2.88
August			2,350	144,496	1	1.15
September			940	55,934	.40	.45
October			470	28,899	.20	.23

[a] Estimated from previous measurements and from run-off of neighboring streams.

Estimated monthly discharge of Kern River at first point of measurement.[b]

[Drainage area, 2,345 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1893.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
October	554	517	534	32,861	0.23	0.26
November	559	467	518	30,827	.22	.24
December	590	430	516	31,757	.22	.25
1894.						
January	741	562	661	40,644	.28	.32
February	1,114	604	717	39,817	.30	.32
March	1,443	762	1,001	61,541	.43	.65
April	1,892	1,209	1,495	88,952	.64	.71
May	2,208	1,228	1,607	98,798	.69	.79
June	1,719	871	1,085	64,557	.46	.51
July	1,051	400	700	43,036	.30	.34
August	549	256	335	20,565	.14	.16
September	382	172	248	14,756	.11	.12
October	263	224	279	17,178	.12	.14
November	268	230	244	14,500	.10	.11
December	805	234	470	28,908	.20	.23
The year	2,208	172	737	533,252	.31	4.40

[b] Authority, Kern County Land Company.

Estimated monthly discharge of Kern River, etc.—Continued.

Month.	Discharge.				Run-off.	
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,616	473	809	49,762	0.34	0.40
February	4,762	675	1,252	69,536	.53	.55
March	3,004	987	1,374	84,437	.59	.67
April	3,897	1,911	2,724	162,076	1.16	1.29
May	5,384	3,100	4,369	268,608	1.86	2.14
June	3,721	2,174	2,906	172,919	1.24	1.37
July	2,063	867	1,482	91,113	.63	.73
August	1,073	354	629	38,665	.27	.31
September	676	290	344	20,469	.15	.17
October	612	276	327	20,106	.14	.16
November	436	308	346	20,588	.15	.17
December	447	368	403	24,779	.17	.20
The year	5,384	276	1,413	1,023,058	.60	8.16
1896.						
January	3,101	377	747	45,931	.32	.37
February	798	559	617	35,489	.26	.28
March	2,089	652	951	58,475	.41	.47
April	1,263	766	972	57,838	.41	.46
May	3,370	934	1,401	86,144	.60	.69
June	3,611	1,244	2,456	146,142	1.05	1.17
July	2,210	741	1,316	82,762	.57	.66
August	741	353	486	29,883	.21	.24
September	473	234	304	18,089	.13	.14
October	425	223	267	16,417	.11	.13
November	416	288	355	21,124	.15	.17
December	426	313	347	21,336	.15	.17
The year	3,611	223	854	619,630	.36	4.95

Estimated monthly discharge of Kern River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1897.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	832	305	373	22,935	0.16	0.18
February	2,306	516	809	44,930	.35	.36
March	2,044	688	923	56,753	.39	.45
April	4,410	1,094	2,914	173,395	1.24	1.38
May	5,342	4,054	4,580	281,613	1.95	2.25
June	4,352	1,289	2,309	137,395	.98	1.09
July	1,536	644	1,006	61,857	.43	.49
August	671	338	469	28,838	.20	.23
September	363	260	295	17,554	.13	.14
October	441	278	340	20,906	.15	.17
November	477	289	355	21,124	.15	.17
December	1,023	327	422	25,948	.18	.21
The year	5,342	260	1,234	893,248	.53	7.12
1898.						
January	400	311	363	22,320	.15	.17
February	923	316	434	24,103	.19	.20
March	485	304	388	23,857	.17	.20
April	1,342	371	710	42,247	.30	.33
May	980	560	735	45,193	.31	.36
June	686	394	551	32,786	.23	.26
July	416	127	244	15,003	.10	.12
August	142	86	120	7,378	.05	.06
September	294	80	116	6,902	.05	.06
October	232	127	160	9,838	.07	.08
November	188	136	166	9,877	.07	.08
December	314	147	199	12,236	.08	.09
The year	1,342	80	348	251,743	.15	2.01

Estimated monthly discharge of Kern River, etc.—Continued.

Month.	Discharge.				Run-off.	
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	361	182	263	16,172	0.11	0.13
February	365	258	302	16,772	.13	.14
March	4,932	247	590	36,278	.25	.29
April	1,167	593	893	53,138	.38	.43
May	1,302	576	835	51,342	.36	.41
June	2,230	809	1,331	79,200	.57	.63
July	894	229	489	30,057	.21	.24
August	240	99	156	9,592	.07	.08
September	117	89	105	6,257	.04	.05
October	229	86	160	9,838	.07	.08
November	385	183	221	13,151	.09	.10
December	781	182	277	17,032	1.18	1.36
The year	4,932	86	468	338,829	.29	3.94
1900.						
January	1,048	266	362	22,259	.15	.17
February	329	238	280	15,550	.12	.12
March	502	307	413	25,394	.18	.21
April	592	387	472	28,086	.20	.22
May	1,969	449	1,111	68,312	.47	.54
June	1,878	841	1,283	76,344	.55	.61
July	850	202	392	24,103	.17	.20
August	217	101	144	8,854	.06	.07
September	270	106	166	9,878	.07	.08
October	186	137	160	9,838	.07	.08
November	1,339	161	349	20,767	.15	.17
December	445	288	373	22,934	.16	.18
The year	1,969	101	459	332,319	.20	2.65

Estimated monthly discharge of Kern River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	2,049	226	493	30,313	0.21	0.24
February	1,963	342	860	47,762	.37	.39
March	1,658	901	1,270	78,089	.54	.62
April	2,632	637	1,398	83,187	.60	.67
May	4,419	2,091	3,032	186,430	1.29	1.49
June	4,332	2,455	3,324	197,792	1.42	1.58
July	3,856	1,120	1,864	114,163	.80	.92
August	1,804	505	968	59,520	.41	.47
September	526	249	345	20,529	.15	.17
October	756	259	317	19,492	.14	.16
November	421	343	377	22,433	.16	.18
December	457	268	323	19,860	.14	.16
The year	4,419	226	1,216	880,020	.52	7.05

KING RIVER.

This river rises on the western slope of the Sierra Nevada in Fresno County, Cal. The waters coming from the high catchment basin are probably of greater value for irrigation purposes than those of any other stream in central California, being used exclusively for the raising of grapes and deciduous fruits in the neighborhood of Fresno, Selma, and Hanford. The summer flow of this river is now entirely diverted, and during the dry season of the last few years the scarcity of water has worked many hardships. There is a large surplus of water in this river in the spring, due to the melting of snows, which is now going to waste, and which, if stored in suitable reservoirs, would bring larger areas under cultivation. The mountainous basin of this river has been systematically explored for reservoir sites. For a detailed statement concerning the hydrography of King River, see Water-Supply Paper No. 58, by J. B. Lippincott. Two gaging stations were formerly maintained on the river, one at Red Mountain and the other at Kingsburg, Cal. The station at Red Mountain, established September 3, 1895, is located 15 miles east of Sanger, Cal., and southwest of Red Mountain. The station is on what is called "the lower section of No. 9" of the lumber flume. It is located at the mouth of the canyon, above all diversions. The bed of the stream is of gravel, and few changes have been noticed in the cross section since the establishment of the station.

Discharge measurements of King River, Fresno County.

Date	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
June 20, 1900	E. G. Hamilton		21.7	Boulder Creek—Crossing of upper trail from Kings River Canyon to Bearskin Meadow.
Aug. 31, 1898	J. B. Lippincott		164	Church ditch (Fresno Canal), near head.
Sept. 4, 1899	S. G. Bennett		151	Do.
Sept. 4, 1900	do		229	Do.
Sept. 24, 1902	L. M. Lawson		121	Church ditch at road crossing.
Do	do		Dry.	Fowler Switch Canal, near head.
Sept. 4, 1899	S. G. Bennett		Dry.	Do.
Do	do		2	Gould Canal, near head.
Sept. 4, 1900	do		84	Do.
Sept. 27, 1900	do		1	Do.
Sept. 4, 1899	do		.3	Kingsburg Canal at head.
Sept. 4, 1900	do		Dry.	Do.
Sept. 24, 1902	L. M. Lawson		4.8	Kingsburg Canal at road crossing.
Sept. 17, 1902	E. T. Perkins		3.5	Dinkey Creek, 75 yards below bridge.
Do	do		1.5	Bear Creek.
Do	do		1.5	Deer Creek.
Sept. 18, 1902	do		7.2	North Fork, 100 yards above trail crossing.
Do	do		3	North Fork Creek below Crown Meadow.
Do	do		5	North Fork, Crown Creek.
Do	do		2	North Fork, Blue Canyon Creek.
Do	do		75	Middle Fork at Simpson Meadow.
Sept. 22, 1902	do		32	Bubbs Creek, 100 yards above junction.
Do	do		29	South Fork, 100 yards below trail crossing.
Do	do		.7	Granite Creek, 50 yards above bridge on trail crossing.
Do	do		1.5	Copper Creek.
Sept. 23, 1902	do		11	Roaring Creek at trail crossing.
Sept. 22, 1902	L. M. Lawson		35	North Fork at mouth.
Sept. 24, 1902	do		31	'76 Canal at Trimmer Springs road crossing.

Discharge measurements of King River, Fresno County—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Sept. 22, 1902	L. M. Lawson		2	Enterprise Canal at Trimmer Springs road crossing.
Sept. 25, 1902	do		74	At bridge, 1 mile north of Reedley.
Jan. 10, 1895	A. P. Davis	6	1,830	Kingsburg.[a]
Mar. 23, 1895	J. B. Lippincott	4.1	500	Do.
Dec. 2, 1895	do	3.3	407	Do.
Apr. 11, 1896	J. A. Vogelson	5.7	1,883	Do.
Feb. 11, 1897	J. B. Lippincott	5.6	905	Do.
Apr. 6, 1897	do	5.2	825	Do.
June 3, 1897	do	8.6	5,959	Do.
July 17, 1897	do	5.2	503	Do.
Sept. 10, 1897	A. Q. Campbell	3.2	221	Do.
Nov. 3, 1897	do	4.8	465	Do.
Dec. 23, 1897	J. B. Lippincott	4.8	522	Do.
May 28, 1898	do	6.2	1,026	Do.
Apr. 21, 1898	do	6.6	1,658	Do.
July 26, 1898	do	3.9	305	Do.
Aug. 30, 1898	do	3.4	94	Do.
Sept. 26, 1902	L. M. Lawson		117	Do.
June 19, 1900	E. G. Hamilton		11.6	Long Valley, 300 feet below junction of Tenmile Creek.
Aug. 26, 1900	H. E. Green		153	Middle Fork at Tehipiti.
May 23, 1900	E. G. Hamilton		6.8	Mill Creek, sec. 13, T. 13 S., R. 24 E.
Aug. 19, 1900	do		4.3	North Fork, Dusy Meadows.
Sept. —, 1900	J. S. Eastwood		15	North Fork.
Sept. 3, 1895	A. P. Davis	4.3	524	Red Mountain.
Nov. 24, 1895	J. B. Lippincott	3.8	248	Do.
Apr. 12, 1896	J. A. Vogelson	6.35	1,745	Do.
June 12, 1896	J. B. Lippincott	10.85	15,941	Do.
Nov. 1, 1896	do	4.2	404	Do.
Feb. 13, 1897	do	5.2	1,021	Do.
Apr. 5, 1897	do	6.82	2,047	Do.
June 1, 1897	do	10.02	8,838	Do.
July 15, 1897	A. Q. Campbell	7.17	3,333	Do.
Sept. 9, 1897	do	4.1	295	Do.

[a] Grade of river at Kingsburg affected by diversion dam of Last Chance Company, 2 miles below.

Discharge measurements of King River, Fresno County—Continued.

Date	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Nov. 1, 1897	A. Q. Campbell	4.57	552	Red Mountain.
Dec. 22, 1897	J. B. Lippincott	4.7	515	Do.
Apr. 20, 1898	do	8.55	4,943	Do.
May 29, 1898	do	7.14	2,672	Do.
July 27, 1898	do	4.32	503	Do.
Aug. 31, 1898	do	3.77	244	Do.
Dec. 21, 1898	do	7.0	2,444	Do.
Apr. 19, 1899	S. G. Bennett	8.8	5,409	Do.
May 15, 1899	do	8.15	4,422	Do.
June 3, 1899	do	7.85	3,954	Do.
June 26, 1899	do	7.23	3,049	Do.
Aug. 2, 1899	do	4.66	608	Do.
Sept. 1, 1899	do	3.80	206	Do.
Dec. 8, 1899	J. B. Lippincott	4.36	458	Do.
Apr. 1, 1900	S. G. Bennett	6.54	2,035	Do.
May 16, 1900	do	9.2	6,436	Do.
June 19, 1900	do	8.59	5,072	Do.
Aug. 10, 1900	do	4.3	427	Do.
Sept. 4, 1900	do	4.28	405	Do.
Sept. 27, 1900	do	3.82	220	Do.
Dec. 29, 1900	do	4.65	576	Do.
Jan. 31, 1901	do	5.4	991	Do.
Feb. 28, 1901	do	7.90	3,593	Do.
Apr. 4, 1901	do	6.40	1,915	Do.
May 21, 1901	J. B. Lippincott	10.5	10,869	Do.
July 30, 1901	S. G. Bennett	7.54	3,179	Do.
Oct. 17, 1901	do	4.1	301	Do.
Sept. 21, 1902	do		217	Do.
Oct. 20, 1900	H. E. Green		346	South Fork, just below junction of Middle Fork.
Sept. 1, 1899	S. G. Bennett		Dry.	"76" ditch at head.
Sept. 1, 1900	do		Dry.	Do.
June 25, 1895	J. B. Lippincott	13.9	10,307	Suspension bridge.
Sept. 2, 1895	A. P. Davis	9.5	525	Do.
Dec. 23, 1897	J. B. Lippincott	4.9	522	Do.

Estimated monthly discharge of King River at Slate Point, Fresno County.[a]

[Drainage area, 1,742 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	300	17,851	0.17	0.19
December	290	17,831	.17	.20
1879.				
January	370	22,750	.21	.24
February	870	48,317	.50	.52
March	1,970	121,131	1.13	1.30
April	4,750	282,645	2.73	3.05
May	5,090	312,972	2.92	3.37
June	3,760	223,736	2.16	2.41
July	1,650	101,455	.95	1.10
August	380	23,365	.22	.25
September	270	16,066	.15	.17
October	289	17,217	.16	.18
November	400	23,802	.23	.26
December	1,440	88,542	.83	.96
The year	1,769	1,281,998	1.02	13.81
1880.				
January	720	44,271	.41	.47
February	1,040	59,821	.60	.65
March	1,120	68,866	.64	.74
April	5,230	311,207	3.00	3.35
May	7,120	437,792	4.09	4.71
June	9,540	567,669	5.48	6.12
July	4,800	295,141	2.76	3.18
August	1,150	70,711	.66	.76
September	370	22,017	.21	.23
October	220	13,527	.13	.15
November	220	13,091	.13	.15
December	510	31,359	.29	.33
The year	2,670	1,935,472	1.53	20.81

[a] Authority, California State engineer.

Estimated monthly discharge of King River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1881.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	870	53,494	0.50	0.58
February	2,430	134,955	1.39	1.45
March	1,900	116,826	1.09	1.26
April	5,800	345,124	3.33	3.71
May	8,220	505,428	4.72	5.44
June	5,010	298,116	2.88	3.21
July	4,790	294,526	2.75	3.17
August	650	39,967	.37	.43
September	340	20,231	.20	.22
October	250	15,372	.14	.16
November	230	13,686	.13	.15
December	260	15,987	.15	.17
The year	2,562	1,853,712	1.47	19.95
1882.				
January	380	23,365	.22	.25
February	440	24,436	.25	.26
March	1,250	76,859	.72	.83
April	3,170	188,628	1.82	2.03
May	9,190	565,071	5.28	6.08
June	6,410	381,421	3.68	4.11
July	2,020	124,205	1.16	1.34
August	620	38,122	.36	.42
September	390	23,207	.22	.25
October	610	37,507	.35	.40
November	470	27,967	.27	.30
December	340	20,906	.20	.23
The year	2,107	1,531,694	1.21	16.46

Estimated monthly discharge of King River, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1883.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	320	19,676	0.18	0.21
February	340	18,883	.20	.21
March	1,050	64,562	.60	.69
April	2,220	132,099	1.27	1.42
May	6,700	411,967	3.85	4.44
June	6,730	400,463	3.86	4.31
July	1,460	89,772	.84	.97
August	600	36,893	.34	.39
September	480	28,562	.28	.31
October	420	25,825	.24	.28
November	260	15,471	.15	.17
December	220	13,527	.13	.15
The year	1,733	1,257,700	.99	13.55
1884.				
January	430	26,440	.25	.29
February	2,620	150,704	1.50	1.62
March	3,610	221,970	2.07	2.39
April	3,370	200,529	1.93	2.15
May	9,210	566,301	5.29	6.09
June	17,630	1,049,058	10.12	11.29
July	13,210	812,251	7.58	8.74
August	3,570	219,511	2.05	2.36
September	880	52,364	.51	.57
October	900	55,339	.52	.60

Estimated monthly discharge of King River at Red Mountain, Fresno County.[a]

[Drainage area, 1,742 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
September	3,920	360	778	46,294	0.45	0.50
October	520	320	371	22,812	.21	.24
November	1,834	250	368	21,898	.21	.23
December	520	250	328	20,168	.19	.22
The year	3,920	250	461	111,172	.27	1.19
1896.						
January	11,020	390	1,474.8	90,682	.85	.98
February	1,140	728	825.4	47,477	.47	.51
March	7,020	820	1,710.6	105,181	.98	1.13
April	4,600	390	1,938.5	115,349	1.11	1.24
May	22,100	1,140	5,918.1	363,890	3.40	3.90
June	18,920	5,160	12,737.3	757,922	7.31	8.15
July	6,680	1,212	3,742.2	230,110	2.15	2.48
August	1,212	590	795.9	48,938	.45	.52
September	590	390	491.3	29,234	.28	.31
October	510	310	350	21,520	.20	.23
November	1,076	390	538.5	32,043	.31	.35
December	550	470	498.4	30,645	.29	.33
The year	22,100	310	2,585.1	1,872,991	1.48	20.13
1897.						
January	624	360	437	26,870	.25	.29
February	6,344	1,100	1,631	90,581	.92	.96
March	4,408	1,240	1,884	115,843	1.06	1.22
April	9,380	1,930	5,318	316,442	2.99	3.33
May	22,732	6,344	14,470	889,731	8.15	9.40
June	10,580	2,520	6,145	365,652	3.45	3.87
July	4,040	1,036	2,177	133,859	1.22	1.41
August	1,100	440	739	45,440	.42	.47
September	480	250	329	19,577	.18	.20
October	572	270	394	24,226	.22	.25
November	2,520	360	692	41,177	.39	.44
December	8,348	572	985	60,566	.55	.63
The year	22,732	250	2,933	2,129,964	1.65	22.47

[a] Authority, United States Geological Survey.

Estimated monthly discharge of King River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1898.	*Sec.-feet.*	*Sec. feet.*	*Sec. feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	624	440	506	31,113	0.29	0.33
February	1,170	480	705	39,154	.40	.41
March	1,170	520	895	55,032	.50	.58
April	7,820	1,036	3,547	211,061	2.00	2.23
May	6,520	2,450	3,536	217,422	1.99	2.29
June	3,280	1,310	2,122	126,267	1.20	1.34
July	1,310	440	696	42,796	.39	.45
August	400	215	320	19,676	.18	.21
September	780	145	204	12,139	.12	.13
October	728	215	320	19,676	.18	.21
November	285	215	231	13,745	.13	.14
December	1,450	180	315	19,369	.18	.21
The year	7,820	145	1,116	807,450	.63	8.53
1899.						
January	1,310	250	513	31,543	.29	.33
February	1,036	440	660	36,655	.37	.39
March	20,200	624	2,165	133,121	1.22	1.41
April	7,300	1,834	4,512	268,483	2.54	2.83
May	4,780	1,450	3,568	219,388	2.01	2.32
June	10,300	2,852	6,077	361,607	3.42	3.81
July	2,852	676	1,411	86,759	.79	.91
August	624	250	411	25,271	.23	.26
September	285	180	215	12,793	.12	.13
October	1,205	180	378	23,242	.21	.24
November	1,240	345	638	37,964	.36	.40
December	5,096	400	991	60,934	.56	.64
The year	20,200	180	1,795	1,297,760	1.01	13.67

Estimated monthly discharge of King River, etc.—Continued.

Month	Discharge.				Run-off.	
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1900.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	12,700	849	1,689	103,853	0.97	1.12
February	849	676	748	41,542	.43	.45
March	2,584	728	1,712	105,267	.98	1.13
April	2,852	1,546	2,098	124,840	1.20	1.34
May	9,400	1,930	5,881	361,609	3.38	3.90
June	7,900	2,986	5,127	305,078	2.94	3.27
July	2,584	572	1,278	78,581	.73	.84
August	624	250	398	24,472	.23	.26
September	520	215	301	17,911	.17	.19
October	440	215	309	19,000	.18	.21
November	15,700	250	1,310	77,950	.75	.83
December	972	572	726	44,640	.42	.48
The year	15,700	215	1,798	1,304,743	1.03	14.02
1901.						
January	43,930	520	4,337	266,672	2.49	2.87
February	7,040	1,040	3,319	190,392	1.90	2.00
March	4,490	2,034	2,965	182,311	1.70	1.96
April	10,840	1,642	4,492	267,293	2.58	2.87
May	21,830	5,548	11,093	682,082	6.37	7.36
June	21,189	7,040	14,363	854,658	8.25	9.20
July	13,240	3,280	6,258	384,789	3.59	4.14
August	6,260	728	2,292	140,930	1.32	1.52
September	780	440	534	31,775	.31	.35
October	2,034	360	535	32,896	.31	.36
November	1,450	480	694	41,296	.40	.45
December	1,170	440	668	41,073	.38	.44
The year	43,930	360	4,296	3,116,167	2.47	33.52

Estimated monthly discharge of King River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1902.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	520	360	440	27,055	0.25	0.29
February	2,852	360	665	36,932	.38	.40
March	4,490	1,040	1,422	87,312	.82	.95
April	26,380	1,450	4,163	247,716	2.39	2.67
May	13,760	3,440	6,532	401,637	3.75	4.32
June	13,240	3,760	8,063	479,782	4.63	5.16
July	3,600	1,040	1,638	100,717	.94	1.08
August	910	320	626	38,491	.36	.42
September	360	250	304	18,089	.17	.19
October	520	215	265	16,294	.15	.17
November	1,170	250	451	26,836	.26	.29
December	1,040	400	497	30,559	.29	.33
The year	26,380	215	2,089	1,511,420	1.20	16.27

LITTLE ROCK CREEK.

Discharge measurements of Little Rock Creek, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
June 2, 1896	J. B. Lippincott	2	Head works Little Rock irrigation district.
Apr. 20, 1896	J. A. Vogelson	7.2	Head works South Antelope Valley Water Company.
June 2, 1896	J. B. Lippincott	1	Do.
Feb. 9, 1897	do	21.3	Do.
Apr. 7, 1897	do	120	Do.
Jan. 5, 1898	do	3	Do.
July 19, 1900	B. Cole	1.4	Pumped water in ciénaga.

LOBETUS CREEK.

Discharge measurement of Lobetus Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Oct. 17, 1893	W. W. Brier	0.18	1 mile above mouth.

LOGSDON AND FARREL DITCH, SAN BERNARDINO COUNTY.

See San Bernardino Valley, Logsdon and Farrel ditch.

LOMA ABAJO.

The Loma Abajo was measured by Charles J. Johansen for the Pacific Improvement Company, as indicated below. The point of measurement was a short distance above the junction with the Gato. At the time of these measurements no water was flowing in the pipe line from the Loma Abajo to the Ontare ranch.

List of discharge measurements of Loma Abajo River in Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Feb. 7, 1890	Charles J. Johansen	3.84	Above junction with Gato.
Feb. 14, 1890	do	3.00	Do.
Feb. 27, 1890	do	5.67	Do.
Mar. 2, 1890	do	3.21	Do.
Mar. 4, 1890	do	3.00	Do.
Mar. 6, 1890	do	2.80	Do.
Mar. 9, 1890	do	2.80	Do.
Mar. 11, 1890	do	2.24	Do.
Mar. 13, 1890	do	2.06	Do.
Mar. 15, 1890	do	2.06	Do.
Mar. 17, 1890	do	1.88	Do.
Mar. 21, 1890	do	1.88	Do.
Mar. 23, 1890	do	1.88	Do.
Mar. 25, 1890	do	1.55	Do.
Mar. 27, 1890	do	1.55	Do.
Mar. 29, 1890	do	1.55	Do.
Mar. 31, 1890	do	1.39	Do.
Apr. 2, 1890	do	1.39	Do.
Apr. 4, 1890	do	1.39	Do.
Apr. 6, 1890	do	1.23	Do.
Apr. 8, 1890	do	1.23	Do.
Apr. 10, 1890	do	1.08	Do.
Apr. 12, 1890	do	1.23	Do.
Apr. 14, 1890	do	1.08	Do.
Apr. 17, 1890	do	.92	Do.
Apr. 18, 1890	do	.76	Do.
Apr. 20, 1890	do	.76	Do.
Apr. 22, 1890	do	.76	Do.
Apr. 24, 1890	do	.76	Do.
Apr. 26, 1890	do	.76	Do.

List of discharge measurements of Loma Abajo River, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Apr. 28, 1890	Charles J. Johansen	0.76	Above junction with Gato.
Apr. 30, 1890	do	.76	Do.
May 2, 1890	do	.76	Do.
May 4, 1890	do	.68	Do.
May 6, 1890	do	.68	Do.
May 8, 1890	do	.60	Do.
May 10, 1890	do	.60	Do.
May 12, 1890	do	.60	Do.
May 14, 1890	do	.46	Do.
May 16, 1890	do	.60	Do.
May 18, 1890	do	.53	Do.
May 20, 1890	do	.53	Do.
May 20, 1890	do	.74	Do.
May 22, 1890	do	.59	Do.
May 24, 1890	do	.59	Do.
May 26, 1890	do	.61	Do.
May 28, 1890	do	.61	Do.
May 30, 1890	do	.59	Do.
June 1, 1890	do	.58	Do.
June 3, 1890	do	.49	Do.
June 5, 1890	do	.49	Do.
June 7, 1890	do	.44	Do.
June 9, 1890	do	.47	Do.
June 11, 1890	do	.47	Do.
June 13, 1890	do	.42	Do.
June 15, 1890	do	.50	Do.
June 17, 1890	do	.56	Do.
June 19, 1890	do	.52	Do.
June 21, 1890	do	.49	Do.
June 23, 1890	do	.42	Do.
June 25, 1890	do	.45	Do.
June 27, 1890	do	.42	Do.
June 29, 1890	do	.37	Do.
July 1, 1890	do	.34	Do.
July 3, 1890	do	.42	Do.
July 5, 1890	do	.26	Do.
July 7, 1890	do	.24	Do.
July 9, 1890	do	.23	Do.
July 11, 1890	do	.24	Do.
July 13, 1890	do	.24	Do.

List of discharge measurements of Loma Abajo River, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 15, 1890	Charles J. Johansen	0.24	Above junction with Gato.
July 17, 1890	do	.20	Do.
July 19, 1890	do	.23	Do.
July 21, 1890	do	.17	Do.
July 23, 1890	do	.20	Do.
July 25, 1890	do	.18	Do.
July 27, 1890	do	.21	Do.
July 29, 1890	do	.21	Do.
July 31, 1890	do	.23	Do.
Aug. 2, 1890	do	.24	Do.
Aug. 4, 1890	do	.26	Do.
Aug. 6, 1890	do	.20	Do.
Aug. 8, 1890	do	.18	Do.
Aug. 10, 1890	do	.24	Do.
Aug. 12, 1890	do	.27	Do.
Aug. 14, 1890	do	.30	Do.
Aug. 17, 1890	do	.12	Do.
Aug. 19, 1890	do	.13	Do.
Aug. 21, 1890	do	.17	Do.
Aug. 23, 1890	do	.11	Do.
Aug. 25, 1890	do	.12	Do.
Aug. 27, 1890	do	.12	Do.
Aug. 29, 1890	do	.11	Do.
Aug. 31, 1890	do	.09	Do.
Sept. 2, 1896	do	.07	Do.
Sept. 4, 1890	do	.08	Do.
Sept. 6, 1890	do	.12	Do.
Sept. 8, 1890	do	.06	Do.
Sept. 10, 1890	do	.09	Do.
Sept. 12, 1890	do	.07	Do.
Sept. 14, 1890	do	.09	Do.
Sept. 16, 1890	do	.09	Do.
Sept. 18, 1890	do	.11	Do.
Sept. 20, 1890	do	.08	Do.
Sept. 22, 1890	do	.09	Do.
Sept. 24, 1890	do	.12	Do.
Sept. 26, 1890	do	.13	Do.
Sept. 28, 1890	do	.14	Do.
Sept. 30, 1890	do	.30	Do.
Oct. 2, 1890	do	.20	Do.

List of discharge measurements of Loma Abajo River, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Oct. 4, 1890	Charles J. Johansen	0.14	Above junction with Gato.
Oct. 6, 1890	do	.14	Do.
Aug. 18, 1890, a. m	do	.07	Below Upper Forks.
Aug. 18, 1890, p. m	do	.04	Do.
Aug. 21, 1890, a. m	do	.11	Do.
Aug. 21, 1890, p. m	do	.04	Do.
May 21, 1890	do	.46	Upper Forks—East Fork.
Do	do	.07	Upper Forks—West Fork.
June 4, 1890	do	.31	Upper Forks—East Fork.
Do	do	.06	Upper Forks—West Fork.

LOPEZ CREEK.

Discharge measurements of Lopez Creek, San Luis Obispo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Nov. 19, 1897	W. W. Brier	5.51	10 miles above Arroyo Grande.

LOS ANGELES RIVER.

Los Angeles River heads immediately south of Santa Clara River, its various tributaries receiving their supply from the mountains surrounding the San Fernando Plains. It passes out of the lower end of the plain through a narrow valley known as The Narrows, at the lower end of which is the city of Los Angeles. The streams entering San Fernando Valley have brought down immense quantities of sand and gravel from the mountainous area, and thus have formed the San Fernando Plains. This coarse deposit acts as a natural regulator, absorbing the flood waters, which gradually appear lower down. The rainfall of Southern California has been deficient for the last few years, but the discharge of Los Angeles River at The Narrows has been exceptionally constant, the decrease in 1900 being not more than 20 per cent of the average. On account of the numerous lawsuits which have arisen regarding water rights on this river, a thorough study of its discharge has been instituted by the city of Los Angeles, the work being under the direction of J. B. Lippincott, as consulting

engineer for the city. The majority of the measurements have been made by C. A. Miller, although a number of them were made by F. H. Olmsted, city engineer. Several weirs have been placed in the river where the measurements are made. The points of measurement are as follows, in order downstream:

Weir A, at the intersection of Pacoima avenue with Los Angeles River, in the Lankershim Rancho subdivision.

Weir B, at the intersection of Vineland avenue with Los Angeles River.

Weir C, at the intersection of Fernando avenue with Los Angeles River.

Weir E, at the southwest corner of block 73, Providencia Rancho.

Weir G, at the intersection of the east line of block 71, Providencia Rancho, with Los Angeles River.

Weir L, 770 feet above weir H.

Weir H, approximately 300 feet east of the intersection of Buena Vista street with Los Angeles River.

Weir I, 2,543 feet below weir H.

Weir J, 600 feet east of the west line of block 69, Providencia Rancho.

Weir K, in block 79, Providencia Rancho, 300 feet west of center.

Measuring bridge P, near the southwest corner of block 81, Providencia Rancho, in the headworks site of the city of Los Angeles, commonly known as the Pomeroy & Hooker tract, where river turns to the east at angle of 90°.

Measuring bridge Q, about 400 feet above the junction of the Verdugo Wash with Los Angeles River.

Measuring bridge No. 2, about 600 feet above the head of the power ditch of the Los Angeles City Water Company, in the so-called Crystal Springs tract.

Weir No. 7, 1 mile below the head, in the main supply ditch, sometimes called the Woolen Mill ditch, in the headworks site.

Measuring point No. 7B, at a 3-foot cement pipe in the same ditch, west of bridge No. 2 and at the Los Felix ranch house.

Weir No. 17, opposite bridge No. 2, on what is called the Glassell tributary.

To get the total flow of river at bridge No. 2, there should be combined the flow at bridge No. 2, weir No. 17, and measuring point No. 7B. In case measurements were not taken on the main supply ditch at No. 7B, the measurement observed at weir No. 7, above No. 7B on the main supply ditch, was used, and the loss between No. 7 and No. 7B, 2.49 second-feet, was deducted. This is shown in detail in the table for bridge No. 2. For bridge Q a similar process is followed, omitting No. 17. For bridge P the observed flow at the bridge is combined with either the flow at No. 7 or at No. 7B.

Weir No. 9, at the mouth of Tujunga Creek, near the western end of the headworks site, and near the intersection of Buena Vista street with Los Angeles River.

Weir No. 10, approximately 200 feet west of weir No. 9, at the outlet of a small cut which was run into the gravel bed for the development of water.

Weir M, block 67, Providencia Rancho, on a small stream entering the river in the headworks tract.

Discharge measurements of Los Angeles River.

AT WEIR A.

Date.	Discharge.	Average for month.	Date.	Discharge.	Average for month.
1899.	*Sec.-feet.*	*Sec.-feet.*	1900.	*Sec.-feet.*	*Sec.-feet.*
August 14	0.565	0.612	May 17	0.461	0.461
August 19	.660		June 12	.461	.431
September 20	.500	.500	June 29	.402	
September 26	.500		August 1	.310	.370
October 24	.687	.687	August 8	.368	
November 24	.725	.723	August 15	.372	
November 28	.721		August 31	.430	
December 7	.678	.723	September 8	.378	.368
December 28	.768		September 11	.400	
			September 27	.328	
			November 10	.380	.380
Mean		.649	Mean		.402

AT WEIR B.

1899.			1900.		
August 14	0.500	0.500	May 17	0.482	0.482
September 20	.500	.500	June 12	.430	.355
September 26	.500		June 29	.280	
October 24	.755	.755	July 27	.160	.160
November 24	.937	.939	August 1	.180	.198
November 28	.941		August 15	.197	
December 7	.864	.923	August 31	.219	
December 28	.982		September 8	.209	.203
			September 11	.223	
			September 27	.176	
			November 10	.260	.260
Mean		.723	Mean		.276

Discharge measurements of Los Angeles River—Continued.

AT WEIR C.

Date.	Discharge.	Average for month.	Date.	Discharge.	Average for month.
1899.	*Sec.-feet.*	*Sec.-feet.*	1900.	*Sec.-feet.*	*Sec.-feet.*
August 14	2.88	2.88	May 17	2.98	2.98
August 28	2.88		June 12	2.91	2.91
September 20	2.69	2.48	July 27	2.45	2.45
September 26	2.26		August 1	2.50	2.50
October 9	2.88	2.93	August 8	2.48	
October 24	2.98		August 15	2.48	
November 24	3.45	3.43	August 31	2.55	
November 28	3.42		September 8	1.58	1.86
December 28	3.44	3.44	September 11	2.38	
			September 27	1.63	
			November 10	2.42	2.42
Mean		3.03	Mean		2.52

AT WEIR E.

1899.			1900.		
August 14	5.55	5.55	May 15	5.45	5.45
August 28	5.55		June 12	5.18	4.99
September 20	5.35	5.30	June 29	4.81	
September 26	5.25		July 12	4.80	4.80
October 25	5.99	5.99	July 27	4.80	
November 17	6.53	6.38	August 1	4.53	4.63
November 28	6.24		August 15	4.47	
December 13	6.24	6.26	August 31	4.88	
December 21	6.24		September 8	4.49	4.48
December 26	6.30		September 11	4.65	
			September 27	4.30	
			November 10	4.67	4.67
Mean		5.89	Mean		4.84

Discharge measurements of Los Angeles River—Continued.

AT WEIR G.

Date.	Discharge.	Average for month.	Date.	Discharge.	Average for month.
1899.	*Sec.-feet.*	*Sec.-feet.*	1900.	*Sec.-feet.*	*Sec.-feet.*
August 14	7.92	7.92	May 15	7.94	7.94
August 28	7.92		June 12	7.63	7.31
September 20	7.60	7.60	June 29	7.00	
September 26	7.60		July 27	6.45	6.45
October 9	7.66	8.13	August 1	6.45	6.70
October 25	8.60		August 15	6.80	
November 17	9.17	9.08	August 31	6.87	
November 28	8.99		September 8	6.72	6.80
December 13	8.90	8.90	September 11	7.00	
December 21	8.90		September 27	6.68	
December 26	8.92		November 13	6.99	6.99
Mean		8.33	Mean		7.03

AT WEIR L.

1899.			1900.		
August 14	9.08	9.00	May 15	8.85	8.79
August 28	8.93		May 23	8.73	
September 20	8.59	8.74	June 12	8.62	8.46
September 26	8.89		June 29	8.30	
October 9	8.59	9.22	July 27	7.53	7.53
October 25	9.58		August 1	7.53	7.71
October 27	9.48		August 8	7.59	
November 17	10.15	10.04	August 15	7.69	
November 28	9.93		August 31	8.02	
December 13	10.02	10.11	September 8	7.82	7.92
December 21	10.02		September 11	8.20	
December 26	10.30		September 27	7.76	
			November 10	8.34	8.34
Mean		9.42	Mean		8.12

Discharge measurements of Los Angeles River—Continued.

AT WEIR H.

Date.	Discharge.	Average for month.	Date.	Discharge.	Average for month.
1899.	*Sec.-feet.*	*Sec.-feet.*	1900.	*Sec.-feet.*	*Sec.-feet.*
August 14	11.88	12.04	May 15	11.42	11.31
August 28	12.19		May 23	11.21	
September 20	11.60	11.82	June 12	11.01	10.84
September 26	12.03		June 29	10.68	
October 9	11.60	12.31	July 27	9.96	9.96
October 25	12.66		August 1	9.96	10.20
October 27	12.66		August 8	10.16	
November 17	13.73	13.60	August 15	10.13	
November 28	13.47		August 31	10.57	
December 13	13.42	13.62	September 8	10.15	10.19
December 21	13.64		September 11	10.39	
December 26	13.80		September 27	10.03	
			November 10	10.54	10.54
Mean		12.68	Mean		10.51

AT WEIR I.

1899.			1900.		
August 14	17.18	17.04	May 15	16.25	16.15
August 28	16.91		May 23	16.05	
September 20	17.15	17.23	June 12	15.66	15.57
September 26	17.32		June 29	15.49	
October 9	17.19	17.76	July 12	15.58	15.16
October 25	18.33		July 27	14.74	
November 17	19.04	18.88	August 1	14.37	14.70
November 28	18.72		August 8	14.94	
December 13	18.93	18.96	August 15	14.69	
December 26	18.99		August 31	14.80	
			September 8	14.54	14.53
			September 11	14.74	
			September 27	14.31	
			November 10	14.92	14.92
Mean		17.97	Mean		15.17

Discharge measurements of Los Angeles River—Continued.

AT WEIR J.

NOTE.—Total discharge of river at weir J equals discharge over weir + discharge at No. 7, or + No. 7B + 2.49.

Date.	Discharge at No. 7, or No. 7B + 2.49.	Discharge over weir.	Total discharge for weir.	Average for month.
1899.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*
August 14	18.59	0.55	19.14	18.76
August 28	17.90	.49	18.39	
September 20	17.90	.49	18.39	18.58
September 26	18.28	.49	18.77	
October 9	18.08	.44	18.52	18.91
October 25	17.45	1.85	19.30	
November 17	18.02	2.91	20.93	20.71
November 28	13.78	6.71	20.49	
December 13	13.90	6.34	20.24	20.31
December 26	13.66	6.73	20.39	
Mean				19.45
1900.				
May 15	20.09	1.39	21.48	19.76
May 23	16.37	1.67	18.04	
June 12	19.81	.86	20.67	18.92
June 29	16.31	.86	17.17	
August 15	18.49	.41	18.90	19.31
August 31	19.25	.46	19.71	
September 8		.42		
September 11	19.81	.52	20.33	19.15
September 27	17.59	.39	17.98	
November 10	14.84	1.49	16.33	16.33
Mean				18.69

Discharge measurements of Los Angeles River—Continued.

AT WEIR K.

NOTE. Total discharge of river at weir K equals discharge over weir + discharge at No. 7, or (No. 7B + 2.49).

Date.	Discharge at No. 7, or No. 7B + 2.49.	Discharge over weir.	Total discharge for weir.	Average for month.
1899.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*
August 14	18.59	4.13	22.72	22.27
August 28	17.90	3.92	21.82	
September 20	17.90	3.91	21.81	22.03
September 26	18.28	3.98	22.26	
October 9	18.08	4.13	22.21	22.68
October 25	17.45	5.70	23.15	
November 17	18.02	6.97	24.99	24.73
November 28	13.78	10.69	24.47	
December 13	13.90	10.69	24.59	24.58
December 26	13.66	10.92	24.58	
Mean				23.26
1900.				
May 15	20.09	4.94	25.03	23.17
May 23	16.37	4.94	21.31	
July 2	16.32	2.93	19.25	19.25
August 1		2.55		
August 15	18.49	2.71	21.20	21.50
August 31	19.25	2.55	21.80	
September 8		2.81		
September 11	19.81	2.80	22.61	21.35
September 27	17.59	2.50	20.09	
November 10	14.84	4.12	18.96	18.96
Mean				20.85

Discharge measurements of Los Angeles River—Continued.

AT BRIDGE P.

NOTE.—Total discharge of river at bridge P equals discharge at bridge + discharge at No. 7, or + discharge at No. 7B.

Date.	Discharge at No. 7, or No. 7B.	Discharge at bridge.	Total discharge at bridge.	Average for month.
1899.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
August 25	18.66	20.22	38.88	38.88
September 20	17.90	19.36	37.26	38.50
September 27	18.66	21.08	39.74	
October 10	18.08	19.81	37.89	37.16
October 25	17.45	17.62	35.07	
October 28	17.45	21.06	38.51	
November 17	18.02	25.73	43.75	42.34
November 28	13.18	27.75	40.93	
December 13	13.90	31.94	45.84	43.58
December 26	13.66	27.67	41.33	
Mean				40.09
1900.				
May 15	17.60	21.22	38.82	36.49
May 23	13.88	20.28	34.16	
June 12	17.32	18.59	35.91	35.91
July 2	13.83	19.51	33.34	32.16
July 12	14.00	16.99	30.99	
August 1	14.00	17.04	31.04	33.23
August 8	14.00	18.71	32.71	
August 15	16.00	19.94	35.94	
September 8		19.26		
September 11	17.32	19.67	36.99	35.23
September 28	15.10	18.38	33.48	
Mean				34.60

Discharge measurements of Los Angeles River—Continued.

AT BRIDGE Q.

NOTE.—Total discharge of river at bridge Q equals discharge at Q + discharge at No. 7 + 2.49, or No. 7B.

Date.	Discharge at No. 7 2.49, or 7B.	Discharge at bridge.	Total discharge at bridge.	Average for month.
1899.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Sec.-feet.*
September 20	15.41	28.12	43.53	43.84
September 27	16.17	27.99	44.16	
October 10	15.59	27.77	43.36	41.31
October 25	8.21	27.66	35.87	
October 28	8.23	36.48	44.71	
November 17	9.36	39.71	49.07	47.58
November 29	12.20	33.89	46.09	
December 13	11.41	35.99	47.40	45.21
December 26	11.17	31.86	43.03	
Mean				44.49
1900.				
May 15	17.60	28.42	46.02	43.93
May 23	13.88	27.97	41.85	
June 12	17.32	27.64	44.96	44.96
July 2	13.83	26.20	40.03	39.41
July 12	14.00	24.79	38.79	
August 1	14.00	24.48	38.48	38.48
September 8		27.09		
September 11	17.32	26.22	43.54	43.98
September 28	15.10	29.33	44.43	
Mean				42.15

Discharge measurements of Los Angeles River, Los Angeles County, near bridge No. 2.

Date.	Hydrographer	Discharge.	Locality.
		Sec.-feet.	
June 15, 1889	Wm. Mulholland	36.7	River.
Do	do	11.1	Power ditch.
Do	do	11.2	Main supply ditch.
	Total flow at bridge 2.	59.0	
July 15, 1889	Wm. Mulholland	33.3	River.
Do	do	11.0	Power ditch.
Do	do	14.1	Main supply ditch.
	Total at bridge 2	58.4	
Nov. 18, 1891	Wm. Mulholland	68.0	River.
Do	do	10.0	Power ditch.
Do	do	3.0	Main supply ditch.
	Total at bridge 2	81.0	
Nov. —, 1893	Wm. Mulholland	58.8	River.
Do	do	15.0	Power ditch.
Do	do	(?)	Main supply ditch.
Feb. 28, 1898	do	51.8	River.
Do	do	.7	Glassell tributary.
Do	do	15.0	Main supply ditch.
Do	do		Power ditch, measurement above.
	Total at bridge 2	67.5	

Discharge measurements of Los Angeles River at bridge No. 2.

NOTE. Total discharge of river at bridge No. 2 equals discharge at No. 2 + discharge at No. 7B or No. 2 + No. 7 − 2.49.

Date.	Discharge at No. 7 2.49, or No. 7B.	Discharge at No. 17.	Discharge at bridge.	Total discharge at bridge.	Average for month.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*
August 19	15.59	0.06	41.29	56.94	57.79
August 25	16.17	.06	42.41	58.64	
September 20	15.41	.06	40.23	55.70	56.00
September 27	16.17	.06	40.07	56.30	
October 10	15.59	.05	39.35	54.99	55.61
October 25	8.21	.05	48.88	57.14	
October 28	8.23	.05	44.45	52.73	
October 31	8.78	.05	48.73	57.56	
November 17	9.36	.06	49.71	59.13	57.39
November 29	12.20	.06	43.40	55.66	
December 13	11.41	.07	46.69	58.17	58.15
December 26	11.17	.07	46.89	58.13	
Mean					56.99
1900.					
May 16	17.60	.14	39.61	57.35	54.91
May 23	13.88	.14	38.46	52.48	
June 12	17.32	.14	39.23	56.69	56.69
July 2	13.83	.10	35.38	49.31	52.43
July 13	15.32	.14	40.10	55.56	
August 1	14.00	.10	34.62	48.72	51.12
August 8	14.00	.10	34.77	48.87	
August 15	16.00	.10	38.58	54.68	
August 31	16.76	.10	35.36	52.22	
September 8			34.27		
September 11	17.32	.20	35.56	53.08	51.27
September 28	15.10	.08	34.28	49.46	
November 10	14.84	.10	39.45	54.39	54.39
Mean					53.46

Average discharge of Los Angeles River at weir No. 9.

Month.	1899.	1900.	Month.	1899.	1900.
	Sec.-feet.	*Sec.-feet.*		*Sec.-feet.*	*Sec.-feet.*
January	1.17	0.52	July	0.55	0.15
February	1.00	.49	August	.48	.18
March	1.16	.39	September	.44	.20
April	1.10	.38	October	.64	
May	.71	.30	November	.56	
June	.69	.24	December	.52	

Average discharge of developed water at weir No. 10.

Month.	1899.	1900.	Month.	1899.	1900.
	Sec.-feet.	*Sec.-feet.*		*Sec.-feet.*	*Sec.-feet.*
January		0.89	July	0.79	0.74
February		.81	August	.79	.73
March	0.96	.86	September	.83	.70
April	.93	.79	October	.86	
May	.90	.82	November	.94	
June	.86	.79	December	.91	

Average discharge of small tributary of Los Angeles River at weir M.

Month.	Discharge.	Month.	Discharge.
1899.	*Sec.-feet.*	1899.	*Sec.-feet.*
January	0.29	July	Dry.
February	.20	August	Do.
March	.20	September	Do.
April	.14	October	Do.
May	.07	November	Do.
June	.06	December	Do.

Average discharge of cut of West Los Angeles Water Company in San Fernando Valley, from gravel beds of Los Angeles River.

Month.	1899.	1900.	Month.	1899.	1900.
	Sec.-feet.	*Sec.-feet.*		*Sec.-feet.*	*Sec.-feet.*
May		5.79	September	6.02	
June		5.85	October	5.94	
July		5.75	November	6.07	
August	6.01	5.87	December	6.08	

Average discharge of Los Angeles River.

Measuring point.	Intervening distance along river.	Average discharge, August to December, inclusive, 1899.	Rate of growth per 100 feet, 1899.	Average discharge May to November, inclusive, 1900.	Rate of growth per 100 feet, 1900.
	Feet.	*Sec.-feet.*		*Sec.-feet.*	
Weir A		0.649		0.402	
	10,280		0.001		0.001
Weir B		.723		.276	
	3,486		.066		.064
Weir C		3.03		2.52	
	7,069		.039		.033
Weir E		5.89		4.84	
	4,585		.053		.048
Weir G		8.33		7.03	
	1,041		.105		.105
Weir L		9.42		8.12	
	770		.424		.310
Weir H		12.68		10.51	
	2,543		.210		.183
Weir I		17.97		15.17	
	3,926		.038		.089
Weir J		19.45		18.69	
	3,600		.100		.060
Weir K		23.06		20.85	
	6,345		.268		.217
Bridge P		40.09		34.60	
	4,629		.095		.163
Bridge Q		44.49		42.15	
	6,756		.185		.167
Bridge No. 2		56.99		53.46	

Discharge measurements of Los Angeles River, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Aug. 21, 1899	S. G. Bennett	0.0	Pacoima, mouth of canyon.
Jan. 9, 1901	L. Mesmer	50.0	Do.
Sept. 20, 1901	S. G. Bennett	0.0	Do.
Aug. 21, 1899	do	.44	Tujunga, Headworks Monte Vista Canal.
Oct. 9, 1900	W. W. Cockins	.19	Do.
Sept. 21, 1901	S. G. Bennett	.22	Do.
Nov. 22, 1900	do	18.7	Tujunga Railroad, main line.
Do	do	.05	Tujunga, 3 miles below above measurement.
Do	do	10.60	Tujunga Railroad, main line, flood marks.
Aug. 21, 1899	do	0.0	Tujunga—little.

Discharge measurements of Los Angeles River at pumping stations in San Fernando Valley.

Year.	Hydrographer.	Discharge.	Remarks.
		Sec.-ft.	
1897	J. B. Lippincott	[a] 0.11	Total output, 4 plants.
1898	do	[a] .33	Total output, 7 plants.
1899	do	[a] .99	Total output, 21 plants.
1900	do	[a] 1.77	Total output, 33 plants.

[a] Reduced to continuous flow for summer months.

LOS FLORES CANYON.

Los Flores Canyon is situated on the southern slope of the Sierra Madre, in Los Angeles County. The area of the drainage basin above the line of township 1 north, above which all diversions occur, is 0.35 square mile. The canyon is in granite, largely shattered, with prevailing lines of cleavage extending northwest to southeast, but with other distinct lines bearing northeastward. Below the mouth of the canyon are the beautiful Pasadena Mesa lands. The scarcity of water, coupled with the general desirability of these lands, has caused much "development work" to be done for the purpose of increasing the water supply. Twelve tunnels in all have been run into this granite rock. The experience has been that as the fissures and cracks of the rock are opened a considerable discharge has resulted for a period of a few weeks, after which the flow decreased, and the tunnels would then again be extended or new ones run.

Following is a list of the tunnels, showing their lengths:

	Feet.
Los Flores tunnel:	
No. 1	23
No. 2	52
No. 3	96
No. 4	55
Mining tunnel	37
Twaddell tunnel	130
McNally tunnel	430
Los Flores tunnel:	
No. 5	185
No. 6	475
No. 7	200
No. 8	357
Twaddell's Tiptop tunnel	132
Total length	2,172

From the nature of the drainage basin and the data obtained from neighboring streams a reasonable natural run-off from this drainage basin, including flood waters, of from 0.10 to 0.15 second-foot might be expected in average years.

The granite bed rock in the drainage basin is covered with a few feet of coarse, disintegrated, granitic soil, very absorbent of water. Rain falling upon this is rapidly absorbed, and the tunnels show within a few weeks the effect of rainfall. During the years when measurements of the tunnels were made the rainfall was, as a rule, much below normal. In the following discharge measurements all the water which is diverted, both developed and natural flow, is included, but probably a few winter storms occurred that produced greater run-off than the capacity of the diversion pipes, and consequently some of the water must have escaped unmeasured.

The lesson to be drawn from this particular case is that the expenditure of the large amount of money required to construct these tunnels was ill advised, the water supply having been not materially, if at all, increased beyond the normal flow of the canyon prior to the construction of the tunnels. A similar experience is the result of like work in Eaton Canyon, which adjoins the Los Flores to the east.

Discharge measurements of Los Flores Canyon, Los Angeles County.

Date.	Mean discharge.	Remarks.
	Sec.-feet.	
1895	0.18	22 inches of rain.
1896	.10	10 inches of rain.
1897	.12	21 inches of rain.
1898	.08	9 inches of rain.
1899	.10	7 inches of rain.
1900	.09	11 inches of rain.
1901	.09	12 inches of raid.

LYTLE CREEK.

This small stream drains the southern slope of the Sierra Madre and discharges its waters on the plains northwest of San Bernardino. Although it drains a comparatively small area of 52 square miles, at the mouth of the canyon its waters are important for irrigation purposes. Owing to the controversies which have arisen over its diversions, a number of lawsuits for the settlement of the claims have been instituted from time to time. A number of measurements of this stream at the mouth of the canyon from 1892 to 1896, inclusive, are given below. They are copied from court records of proceedings in which the water supply of this creek was involved. These cases were tried in the San Bernardino courts by Judge J. W. McKinley. The measurements were made by A. H. Koebig and G. O. Newman, on weirs, and are believed to be accurate.

Discharge measurements of Lytle Creek at mouth of canyon, San Bernardino County, Cal.

Date.	Discharge.	Date.	Discharge.
1892.	*Second-feet.*	1894.	*Second-feet.*
June 3	35.58	August 19	11.44
September 20	18.70	August 25	12.32
September 30	22.04	October 3	16.20
October 28	20.64	1895.	
November 21	22.04	September 2	56.10
November 27	20.68	September 30	40.78
1893.		1896.	
September 7	49.20	March 3	18.08
September 18	49.20	April 23	19.14
September 25	46.34	April 24	18.60
October 4	45.30	April 25	20.52
1894.		May 3	18.52
June 6	17.96	May 4	17.26
June 8	15.50	May 10	18.16
July 10	13.22	May 25	15.32
July 11	13.22	May 26	12.84
July 25	13.36		

Beginning in 1894, measurements of Lytle Creek were also made by H. D. Sibley, who was zanjero of the Lytle Creek canals at that time. The measurements were usually made because the discharge of the stream was below normal. In the winter and spring only the amount of water needed for irrigation was turned into the ditches, but later in the summer the entire flow was diverted. These measurements also were made over weirs and are believed to be fairly accurate. During 1898 trouble was experienced through miners' taking the water from the natural channel and turning it into dry channels, sluice boxes, weirs, mill races, etc., thereby causing an alleged loss of from 20 to 25 per cent of the total flow of the creek. Only a portion of these latter diversions were returned to the creek. The measurements of Mr. Sibley would not show the full flow of Lytle Creek at all times, and sometimes show less than the full discharge, for the reasons mentioned above. During 1899 the amount of water which was diverted into the main canal was measured daily by the Anglo-American Canaigre Company, at a weir erected near the head of its cement ditch. The volumes given have been occasionally checked by visiting the canal and making meter measurements. It is believed that during 1899 practically all the water of the stream was diverted into the canal.

Discharge, in second-feet, of Lytle Creek main canal above Rialto, San Bernardino County, Cal.

[Drainage area, 52 square miles.]

1894.

Day	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1			15.5					
2								
3		24.1	17.2		10.9		13.5	
4								
5	16.1			10.8				
6		22.6						
7			14.1				11.4	14.5
8	19.9				10.8	13.0		
9								13.7
10								
11	17.8	18.5	14.3	10.8			13.7	
12								
13	21.8			13.4				
14			14.3			13.2		
15								
16	22.6		14.4					
17		19.1						
18			15.0		13.7	11.5	14.5	
19	22.6			14.1				
20								
21			14.8	12.7				
22	24.9				11.9	12.7		12.9
23			14.6					
24		18.2	14.9					
25	25.4						14.2	
26								
27			15.0					
28		16.6						
29								
30								12.5
31				11.7	13.4			

Discharge, in second-feet, of Lytle Creek main canal, etc.—Continued.

1895.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			54.4						
2									
3							36.9		
4			68.0			51.4			
5									
6									
7								30.5	
8		33.9					31.5		
9									
10						48.8			
11								24.9	
12						50.8			
13									22.0
14									
15									
16					50.4				
17						44.8			
18	26.4	43.8					41.9		
19									
20									
21		57.5					36.5		
22							34.1	24.0	
23	37.4				52.5				
24						47.1			
25									
26					54.4				
27									
28						36.5	34.5		
29									
30									
31							34.5		

June 5 to August 16, ditch broken; no measurements.

Discharge, in second-feet, of Lytle Creek main canal, etc.—Continued.

1896.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					17.8				13.9			
2				22.2		14.1	11.1					
3												
4												
5	20.0									12.2		
6						11.4			12.2			
7								11.5				
8		19.2					11.1					
9						13.5				11.6		16.0
10						12.5			12.2			
11												
12						11.9		10.5				
13		18.4										
14						12.2	12.2					16.0
15				24.9								
16	21.4				17.1			13.7	10.8			17.0
17			19.8									
18				19.7				11.3				
19									11.8			
20							10.5					
21								12.0				
22												16.0
23								12.5		11.1		
24				22.4				12.5				
25											28.0	
26									11.8	20.0		
27							10.7					
28								13.5				
29		17.5										
30					15.0							24.0
31												

Heavy rains March 1 to 15 and October 26; all water turned out of canal.

Discharge, in second-feet, of Lytle Creek main canal, etc.—Continued.

1897.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.
1								
2								
3		60.0						
4					36.0			
5								
6			60.0					
7		24.0						
8								
9				50.0	30.0			
10	16.0							
11								
12								10.6
13								
14			60.0					
15								
16	24.0				34.0			
17								
18		80.0						
19				60.0				
20								
21		50.0						
22								
23								
24				50.0				
25	20.0		60.0					
26								
27								
28		56.0	70.0	40.0				
29	28.0							
30								
31								

Heavy rains February 3 and 18, March 28, September 14. Chicala Water Company took charge of station June 1.

Discharge, in second-feet, of Lytle Creek main canal, etc.—Continued.

1898.

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1			10.9	12				23			
2				13				24			
3				14				25			
4				15		13.9		26			
5				16				27			
6				17				28	14.6	9.0	
7				18				29			
8				19				30			
9				20		11.5		31			
10				21							
11				22		11.7					

No measurements for January to April, inclusive, and August to December, inclusive.

Discharge, in second-feet, of Lytle Creek main canal, etc.—Continued.

1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.1	11.8	11.2	9.7	11.2	12.2	6.3	9.4	14.5	10.9	10.5	11.1
2	11.1	12.1	11.1	8.9	10.9	10.4	6.8	10.4	15.1	10.8	10.3	11.3
3	12.1	12.1	11.2	8.5	10.9	9.7	6.4	9.6	16.6	10.8	10.3	11.4
4	11.4	12.4	11.1	12.6	10.5	9.5	6.4	10.7	16.7	10.8	10.6	11.1
5	11.7	12.4	10.8	12.5	10.5	9.4	6.4	12.2	16.0	10.7	10.5	11.3
6	11.6	12.5	10.6	12.1	10.5	9.6	6.4	11.0	16.0	10.6	10.6	11.3
7	11.6	12.6	10.4	11.9	10.5	9.2	6.3	10.8	16.0	10.1	10.6	11.3
8	11.6	12.4	10.4	11.8	10.2	9.0	6.2	11.0	15.9	9.9	9.9	11.6
9	11.6	12.1	10.9	11.7	11.8	.....	6.2	11.0	16.5	10.2	9.9	11.4
10	12.0	11.8	10.6	11.9	9.5	7.2	6.0	8.7	16.1	10.8	10.0	11.5
11	16.1	11.8	10.6	11.7	9.5	7.5	5.9	12.0	16.0	11.7	10.2	11.4
12	13.1	11.8	10.6	11.7	9.2	8.2	6.0	12.0	15.8	[a]12.1	10.5	11.3
13	12.2	11.8	10.7	11.0	9.6	8.1	5.9	12.2	15.3	12.4	10.9	11.2
14	12.0	11.6	10.7	10.6	9.5	7.8	5.9	12.1	15.4	13.5	11.0	11.1
15	11.9	11.5	10.7	10.6	9.8	.....	6.0	12.3	16.0	12.7	11.3	11.2
16	12.0	11.5	15.3	10.7	9.4	7.6	6.0	12.3	15.5	13.0	11.7	12.9
17	12.0	11.5	14.7	10.6	9.4	7.8	5.8	12.2	15.3	13.0	11.5	11.8
18	12.0	11.3	13.7	10.7	9.4	7.9	5.4	12.6	14.3	12.3	12.0	11.8
19	11.9	11.4	12.3	10.2	9.7	7.7	5.6	13.0	15.7	12.0	11.9	11.6
20	11.8	11.3	13.7	10.8	9.8	7.3	5.6	13.0	14.9	11.4	11.8	11.6
21	11.7	11.3	13.1	9.9	9.5	7.5	5.8	12.5	15.2	11.2	12.2	11.3
22	11.8	11.3	12.9	9.9	9.4	7.6	7.2	12.4	16.1	11.6	12.7	11.1
23	11.7	11.3	12.8	10.3	9.4	7.4	8.6	12.4	10.8	11.9	12.1	11.1
24	11.6	11.8	13.2	10.6	9.2	7.1	9.3	12.5	10.4	10.3	12.0	11.1
25	11.6	11.4	14.8	10.5	9.2	7.2	8.9	12.4	10.3	10.7	13.8	10.9
26	11.6	11.4	13.5	10.4	9.0	7.4	9.2	12.6	10.3	11.4	11.7	11.2
27	11.6	11.3	13.4	10.4	9.0	7.3	9.4	12.5	10.5	11.3	11.5	11.1
28	11.6	11.3	13.6	10.4	9.0	7.2	9.5	12.2	10.5	11.1	11.5	11.1
29	11.6	.....	13.6	11.0	9.4	6.7	9.7	12.3	10.6	11.0	11.4	11.2
30	11.6	.....	13.5	11.2	9.3	6.4	9.6	12.2	10.6	11.4	11.2	11.1
31	11.7	.....	13.5	.....	.....	.....	10.0	12.1	.....	11.3	.....	11.3
Mean	11.9	11.7	12.2	10.8	9.8	8.1	7.1	11.8	14.3	13.3	11.2	11.3

[a] Rain in mountains.

The summer of 1898 was one during which the smallest stream flow occurred in southern California of which we have record. The period of smallest summer flow was during the month of September. During this minimum period the Edison Electric Company had certain measurements made on Lytle Creek at half hour intervals, to determine the diurnal fluctuations. The discharge of the stream was as follows:

Discharge measurements of Lytle Creek at Millers Narrows, San Bernardino County.

Date.	Time.	Discharge.	Date.	Time.	Discharge.
		Sec.-feet.			*Sec.-feet.*
Sept. 15, 1898	7 a. m.	9.16	Sept. 15, 1898	10.30 p. m.	8.88
Do	7.30 a. m.	9.16	Do	11 p. m.	8.88
Do	8 a. m.	9.16	Do	11.30 p. m.	8.88
Do	8.30 a. m.	9.16	Do	12 midnight	9
Do	9 a. m.	9.00	Sept. 16, 1898	12.30 a. m.	9
Do	9.30 a. m.	7.94	Do	1 a. m.	9
Do	10 a. m.	8.02	Do	1.30 a. m.	9.16
Do	10.30 a. m.	8.02	Do	2 a. m.	9.16
Do	11 a. m.	8.02	Do	2.30 a. m.	9.16
Do	11.30 a. m.	7.74	Do	3 a. m.	9.16
Do	12 m.	7.46	Do	3.30 a. m.	9.16
Do	12 30 p. m.	7.34	Do	4 a. m.	9.16
Do	1 p. m.	7.20	Do	4.30 a. m.	9.16
Do	1.30 p. m.	7.20	Do	5 a. m.	9.16
Do	2 p. m.	7.20	Do	5.30 a. m.	9.16
Do	2.30 p. m.	7.20	Do	6 a. m.	9.16
Do	3 p. m.	7.06	Do	6.30 a. m.	9.16
Do	3.30 p. m.	7.06		12-hour mean	8.86
Do	4 p. m.	6.94			
Do	4.30 p. m.	7.06	Sept. 16, 1898	7 a. m.	9.28
Do	5 p. m.	7.06	Do	7.30 a. m.	9.28
Do	5.30 p. m.	7.34	Do	8 a. m.	9.16
Do	6 p. m.	7.46	Do	8.30 a. m.	9
Do	6.30 p. m.	7.46	Do	9 a. m.	9
	12-hour mean	7.77	Do	9.30 a. m.	8.02
			Do	10 a. m.	8.02
Sept. 15, 1898	7 p. m.	7.46	Do	10.30 a. m.	7.74
Do	7.30 p. m.	7.74	Do	11 a. m.	7.74
Do	8 p. m.	8.40	Do	11.30 a. m.	7.46
Do	8.30 p. m.	8.58	Do	12 m.	7.20
Do	9 p. m.	8.52	Do	12.30 p. m.	7.20
Do	9.30 p. m.	8.72	Do	1 p. m.	7.06
Do	10 p. m.	8.88	Do	1.30 p. m.	6.94

Discharge measurements of Lytle Creek at Millers Narrows, etc.—Continued.

Date.	Time.	Discharge.	Date.	Time.	Discharge.
		Sec.-feet.			*Sec.-feet.*
Sept. 16, 1898	2 p. m.	6.80	Sept. 16, 1898	10.30 p. m.	9
Do	2.30 p. m.	6.94	Do	11 p. m.	9
Do	3 p. m.	7.20	Do	11.30 p. m.	9
Do	3.30 p. m.	7.20	Do	12 midnight	9
Do	4 p. m.	7.34	Sept. 17, 1898	12.30 a. m.	9.16
Do	4.30 p. m.	7.34	Do	1 a. m.	9.16
Do	5 p. m.	7.46	Do	1.30 a. m.	9.16
Do	5.30 p. m.	7.46	Do	2 a. m.	9.16
Do	6 p. m.	7.60	Do	2.30 a. m.	9.16
Do	6.30 p. m.	7.60	Do	3 a. m.	9.16
	12-hour mean	7.75	Do	3.30 a. m.	9.16
			Do	4 a. m.	9.16
Sept. 16, 1898	7 p. m.	8.02	Do	4.30 a. m.	9.06
Do	7.30 p. m.	8.88	Do	5 a. m.	9.28
Do	8 p. m.	8.88	Do	5.30 a. m.	9.28
Do	8.30 p. m.	8.88	Do	6 a. m.	9.28
Do	9 p. m.	8.88	Do	6.30 a. m.	9.28
Do	9.30 p. m.	8.88		12-hour mean	9.04
Do	10 p. m.	9			

The following measurements were made by the United States Geological Survey:

Discharge measurements of Lytle Creek at mouth of canyon, San Bernardino County.

Date.	Hydrographer.	Discharge.	Date.	Hydrographer.	Discharge.
		Sec.-feet.			*Sec.-feet.*
July 24, 1896	J. H. Quinton	15.7	June 8, 1900	S. G. Bennett	6.2
June 10, 1898	J. B. Lippincott	10.7	Sept. 29, 1900	W. W. Cockins, jr	4.6
Aug. 27, 1898	F. H. Olmsted	10.0	Apr. 4, 1902	S. G. Bennett	19.9
Aug. 29, 1899	S. G. Bennett	12.5	Sept. 5, 1902	W. B. Clapp	5.0

MAMMOTH CREEK.

See Owens River, Mammoth Creek.

MARIA IGNACIA CREEK.

Discharge measurement of Maria Ignacia Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
		Sec. feet.
Aug. —, 1899	Geo. F. Wright	0.2[illegible]

MARIPOSA CREEK.

Estimated monthly discharge of Mariposa Creek at base of foothills, Mariposa County.[a]

[Drainage area, 122 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	0	0	0	0	0	0
December	0	0	0	0	0	0
1879.						
January	0	0	0		0	0
February			20	1,111	.16	.17
March			45	2,767	.37	.43
April			43	2,559	.35	.39
May			4	246	.03	.03
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December			15	922	.12	.14
The year			11	7,605	.09	1.16
1880.						
January			20	1,230	.16	.18
February			49	2,819	.40	.43
March			24	1,476	.20	.23
April			24	1,428	.20	.22
May			18	1,107	.15	.17
June			12	714	.10	.11
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December			92	5,657	.75	.86
The year			20	14,431	.16	2.20

[a] Authority, California State engineering department. Estimated from run-off of neighboring streams.

Estimated monthly discharge of Mariposa Creek, etc—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean		Per square mile.	Depth.
1881.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			134	8,239	1.10	1.27
February			171	9,497	1.40	1.46
March			38	2,337	.31	.36
April			5	298	.04	.04
May			0	0	0	0
June			0	0	0	0
July			0	0	0	0
August			0	0	0	0
September			0	0	0	0
October			0	0	0	0
November			0	0	0	0
December			0	0	0	0
The year			29	20,371	24	3.13
1882.						
January	0	0	0	0	0	0
February			24	1,333	.20	.21
March			74	4,550	.61	.70
April			98	5,831	.80	.89
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November		0	18	1,071	.15	.17
December			12	738	.10	.12
The year			19	13,523	.15	2.09

Estimated monthly discharge of Mariposa Creek, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	.....	.....	49	3,013	0.40	0.46
February	.....	.....	24	1,333	.20	.21
March	.....	.....	122	7,501	1.00	1.15
April	.....	.....	73	4,344	.60	.67
May	.....	0	37	2,275	.30	.35
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	.....	.....	25	18,466	.21	2.84
1884.						
January	.....	0	12	738	.10	.12
February	.....	.....	488	28,070	4.00	4.31
March	.....	.....	671	41,258	5.50	6.34
April	.....	.....	488	29,037	4.00	4.46
May	.....	.....	244	15,003	2.00	2.31
June	.....	.....	122	7,259	1.00	1.12
July	.....	0	49	3,013	.40	.46
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0

MAYBERRY CANYON.

Discharge measurements of Mayberry Canyon, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Oct. 19, 18[illegible]	J. B. Lippincott	1.40	Alhambra water—including pumped water.
	do	.24	Mayberry water—including pumped water.
	Total flow of canyon	1.64	
Sept. 23, 1899	J. B. Lippincott	1.38	Alhambra water—including pumped water.

McCLOUD RIVER.

Discharge measurements of McCloud River, Shasta County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-ft.	
Sept. 9, 1901	S. G. Bennett	1,096	One-fourth mile above United States fishery.
Sept. 23, 1902	do	1,272	At Hirze Mountain.
Sept. 24, 1902	Chas. A. Miller	1,325	1 mile above Squaw Creek.
Sept. 26, 1902	do	1,356	United States fishery.
Sept. 24, 1902	do	67	Squaw Creek at bridge above mouth.

McINTYRE DITCH.

See San Bernardino Valley, McIntyre ditch.

McKENZIE DITCH.

See San Bernardino Valley, McKenzie ditch.

MEEKS & DALEY DITCH.

See San Bernardino Valley, Meeks & Daley ditch.

MERCED RIVER.

Merced River above Merced Falls drains approximately 1,090 square miles of the western slopes of the Sierra Nevada. Included in the eastern portion of its drainage area are a large number of high peaks, the highest, Mount Lyell, reaching an elevation of 13,090 feet.

The midsummer flow of this stream is larger in proportion to its drainage area than that of the Tuolumne River, which adjoins it on the north.

In their plunge into the Yosemite Valley the waters of the Merced River and its tributaries form most beautiful waterfalls.

The measurement and record of this stream was undertaken in response to numerous requests from persons interested in mining and irrigation. The midsummer flow of the stream is less than the combined capacity of the irrigation and power canals taking water in the vicinity of Snelling. The owners of these canals offered to pay $100 toward the expenses of equipping and maintaining the gaging station for the first year. Mr. H. H. Henderson, county surveyor of Merced County, established a gaging station at a point 1 mile above Merced Falls, April 6, 1901. Meter measurements are made from a cable. The observer is Mr. Charles Siegfeldt.

Discharge measurements of Merced River, Merced County.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
		Feet.	*Sec.-feet.*	
Sept. 11, 1899	S. G. Bennett		35	River, 1 mile above headworks Crocker-Hoffman Canal.[a]
Do	do		5	Old Mill Valley ditch.
Do	do		16.5	Crocker-Hoffman Canal, 300 feet below headworks.
Sept. 10, 1900	do		6.5	Do.
Sept. 4, 1902	L. M. Lawson		37	Crocker-Hoffman Canal, 3 miles below Snelling.
Nov. 27, 1895	J. B. Lippincott		125	Merced Falls.
Sept. 10, 1900	S. G. Bennett		63	Do.
Apr. 6, 1901	do	10.3	1,379	Do.
June 11, 1901	J. B. Lippincott	12	4,139	Do.
Aug. 2, 1901	S. G. Bennett	10.05	1,122	Do.
Aug. 31, 1901	do	8.6	220	Do.
Mar. 6, 1902	do	10.1	1,202	Do.
May 13, 1902	do	12.15	5,413	Do.
Sept. 3, 1902	L. M. Lawson		109	Do.
Sept. 10, 1900	S. G. Bennett		27	Merced River Mills Canal, 2 miles below Snelling.
Do	do		2.1	Snelling ditch.
Aug. 22, 1896	J. B. Lippincott		89	Yosemite Valley, Stoneman House.

[a] Several small ditches are taken out of Merced River above this point.

Discharge measurements of Merced River, Merced County—Continued.

Date	Hydrographer.	Gage height.	Discharge.	Remarks.
		Feet.	*Sec.-feet.*	
Sept. 25, 1894	N. C. Ray		135	Sec. 6, T. 4 S., R. 17 E., M. D. M.; floats.
Sept. 10, 1895	do		680	Sec. 36, T. 3 S., R. 16 E., M. D. M.; floats.
Mar. 25, 1899	do		4,000	Sec. 22, T. 3 S., R. 16 E., M. D. M.; floats.
Sept. 20, 1899	J. H. McKenzie		64	Sec. 6, T. 4 S., R. 17 E., M. D. M.; estimated.
Oct. 20, 1899	N. C. Ray		1,050	Sec. 22, T. 3 S., R. 16 E., M. D. M.; floats.
Sept. 3, 1900	do		55	Flume at Nameless Mining Co.'s dam; all water turned in.
Nov. 22, 1900	do		20,228	Over crest of Nameless Mining Co.'s dam.
Oct. —, 1901	A. Britt		67	Over weir during construction of Mas. C. and M. Co.'s dam.
Sept. 3, 1902	E. T. Perkins		33	150 yards above junction of Illilonette.
Do	do		2.7	Tenaya River, 50 yards above bridge.
Do	do		6.2	Illilonette River, 100 yards above junction of Merced.
Sept. 4, 1902	do		2	Bridal Veil Creek, below bridge in Yosemite Valley.
Do	do		3.2	South Fork at Wawona, below all buildings.
Aug. 30, 1902	L. M. Lawson		76	Benton Mills power flume at Benton Mills.
Aug. 31, 1902	do		97	Horseshoe Bend.
Sept. 1, 1902	do		15	Ditch below power house at Merced Falls.
Do	do		78	1,000 feet below Merced Falls.

Estimated monthly discharge of Merced River at Merced Falls, Merced County.[a]

[Drainage area, 1,076 square miles.]

Month.	Discharge.				Run-off.	
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1879.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			354	21,767	0.33	0.38
February			1,506	83,639	1.40	1.46
March			2,098	129,001	1.95	2.25
April			3,120	185,653	2.90	3.24
May			3,336	205,123	3.10	3.57
June			3,336	198,506	3.10	3.46
July			968	59,520	.90	1.04
August			172	10,576	.16	.18
September			75	4,463	.07	.08
October			75	4,612	.07	.08
November			172	10,235	.16	.18
December			646	39,721	.60	.69
The year			1,321	952,816	1.23	16.61
1880.						
January			387	23,796	.36	.42
February			753	43,313	.70	.75
March			807	49,621	.75	.86
April			4,250	252,893	3.95	4.41
May			4,842	297,723	4.50	5.19
June			5,111	304,126	4.75	5.30
July			2,744	168,722	2.55	2.94
August			753	46,300	.70	.81
September			323	19,220	.30	.33
October			269	16,540	.25	.29
November			237	14,102	.22	.25
December			1,291	79,380	1.20	1.38
The year			1,814	1,315,736	1.69	22.93

[a] Authority, state engineer, from 1879 to 1884, inclusive. Figures for January, February, and March, 1879, May, June, and July, 1881, November and December, 1882, and the years 1883 and 1884, are estimated from the run-off of neighboring streams. Those from April, 1879, to April, 1881, and from August, 1881, to October, 1882, inclusive, are estimated in part from rod records.

Estimated monthly discharge of Merced River at Merced Falls, etc.—Continued.

Month	Discharge.				Run-off	
	Maximum.	Minimum	Mean	Total discharge	Per square mile.	Depth.
1881.	*Sec.-feet.*	*Sec. feet.*	*Sec. feet*	*Acre-feet.*	*Sec. feet.*	*Inches.*
January			2,044	125,681	1.90	2.19
February			3,443	191,214	3.20	3.33
March			1,560	95,921	1.45	1.67
April			2,798	166,493	2.60	2.90
May			4,412	271,283	4.10	4.73
June			3,336	198,506	3.10	3.46
July			1,506	92,600	1.40	1.61
August			377	23,181	.35	.40
September			129	7,676	.12	.13
October			75	4,612	.07	.08
November			75	4,463	.07	.08
December			323	19,860	.30	.35
The year			1,673	1,201,489	1.55	20.93
1882.						
January			172	10,576	.16	.18
February			753	41,820	.70	.73
March			1,506	92,600	1.40	1.61
April			2,260	134,479	2.10	2.34
May			3,658	224,922	3.40	3.92
June			3,336	198,506	3.10	3.46
July			1,076	66,161	1.00	1.15
August			215	13,220	.20	.23
September			129	7,676	.12	.13
October			484	29,760	.45	.52
November			387	23,028	.36	.40
December			237	14,573	.22	.25
The year			1,184	857,319	1.10	14.92

Estimated monthly discharge of Merced River at Merced Falls, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			344	21,152	.32	.37
February			355	19,716	.33	.34
March			915	56,261	.85	.98
April			2,260	134,479	2.10	2.34
May			5,488	337,444	5.10	5.88
June			4,412	262,532	4.10	4.57
July			1,184	72,801	1.10	1.27
August			377	23,181	.35	.40
September			237	14,102	.22	.25
October			183	11,252	.17	.20
November			161	9,580	.15	.17
December			172	10,576	.16	.18
The year			1,341	973,076	1.25	16.95
1884.						
January			237	14,573	.22	.25
February			2,712	155,996	2.52	2.72
March			3,820	234,883	3.55	4.09
April			4,896	291,332	4.55	5.07
May			5,434	334,124	5.05	5.82
June			6,510	387,372	6.05	6.75
July			4,358	267,963	4.05	4.67
August			1,130	69,481	1.05	1.21
September			237	14,102	.22	.25
October			172	10,576	.16	.18

Estimated monthly discharge of Merced River, Merced County, 1 mile above Merced Falls.[a]

[Drainage area, 1,030 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
April	5,000	1,090	2,687	133,240	1.55	1.73
May	9,450	2,700	5,419	333,201	4.97	5.73
June	8,220	3,380	5,389	320,678	4.94	5.51
July	4,560	1,090	2,096	128,878	1.92	2.21
August	2,090	220	704	43,287	.65	.75
September	250	130	183	10,889	.17	.19
October	990	150	265	16,294	.24	.28
November	730	0	399	23,742	.37	.41
December	2,090	220	577	35,478	.53	.61
1902.						
January	410	195	236	14,511	.22	.25
February	4,020	170	749	41,597	.69	.72
March	5,720	460	1,367	84,054	1.25	1.44
April	5,460	730	2,457	146,202	2.25	2.51
May	6,240	2,180	3,795	233,345	3.48	4.01
June	5,460	1,220	3,142	186,962	2.88	3.21
July	1,110	280	481	29,576	.44	.51
August	320	110	191	11,744	.18	.21
September	110	65	88	5,236	.08	.09
October	280	65	90	5,534	.08	.09
November	1,110	90	246	14,638	.23	.26
December	1,340	195	303	18,631	.28	.32
The year	6,240	65	1,095	792,030	1.01	13.62

[a] U. S. Geol. Survey.

MILL CREEK.

See King River, Mill Creek.

MILL CREEK.

This stream is one of the larger tributaries of Santa Ana River, although on account of its importance for irrigation it is generally considered as an independent stream. It rises on the western slope of the San Bernardino Mountains, draining the area immediately south of the headwaters of Santa Ana River. Mill Creek appears from its canyon about 5 miles east of Redlands. The Crafton Water

Company diverts all the water of this creek at the mouth of the canyon, particularly in the summer. The water passes over a weir, and the volume is therefore determined with considerable accuracy.

Discharge measurements of Mill Creek at headworks Crafton Canal, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Nov. 9, 1898	F. H. Olmsted	15.2
Dec. 8, 1898	do	12.6
July 15, 1899	S. G. Bennett	7.4
July 23, 1898	J. B. Lippincott	11.8
Jan. 12, 1899	S. G. Bennett	10.8
Apr. 29, 1898	J. B. Lippincott	18.9
Oct. 2, 1900	W. W. Cockins, jr	[a] 8.6
Apr. 12, 1898	J. B. Lippincott	15.7
June 12, 1898	do	18.1
Sept. 8, 1898	do	13.1
Oct. 18, 1898	F. H. Olmsted	15.3
Mar. 23, 1899	S. G. Bennett	15.6
May 6, 1899	do	14.6
May 31, 1899	do	11.6
June 15, 1899	do	6.8
July 27, 1899	do	4.3
Aug. 24, 1899	do	[b] 5.7
Do	do	[c] 1.5
Apr. 14, 1900	do	10.8
July 13, 1900	do	[b] 5.4
Do	do	[c] 3.4
Mar. 30, 1901	do	20.0
May 5, 1900	do	[b] 39.0
Do	do	[d] 8.0
July 6, 1901	do	23.3
Feb. 18, 1899	do	10.4
July 29, 1896	J. H. Quinton	14.2
Dec. 5, 1901	S. G. Bennett	14.5
Apr. 5, 1902	do	15.7
Do	do	[b] 5.4
May 31, 1902	do	19.2
July 10, 1902	do	10.8
Sept. 3, 1902	W. B. Clapp	5.3
Nov. 5, 1902	S. G. Bennett	12.3

[a] Of which 1.35 is pumped. [b] In creek. [c] Pumped. [d] Canal.

Discharge measurements of Mill Creek at Mountain Home, San Bernardino County.

[Measurements made by Edison Electric Company.]

Date.	Discharge.
Sept. 15, 1898:	*Sec.-feet.*
7 a. m	11.74
7.30 a. m	11.74
8 a. m	11.58
8.30 a. m	11.74
9 a. m	11.74
9.30 a. m	11.42
10 a. m	11.26
10.30 a. m	11.26
11 a. m	11.08
11.30 a. m	10.78
12 m	10.48
12.30 p. m	10.32
1 p. m	10
1.30 p. m	9.84
2 p. m	9.54
2.30 p. m	9.40
3 p. m	9.24
3.30 p. m	9.24
4 p. m	9.24
4.30 p. m	9.24
5 p. m	9.24
5.30 p. m	9.24
6 p. m	9.54
6.30 p. m	9.54
12-hour mean	10.35
Sept. 15, 1898:	
7 p. m	9.54
7.30 p. m	9.42
8 p. m	9.84
8.30 p. m	9.84
9 p. m	10
9.30 p. m	10.16
10 p. m	10.36
10.30 p. m	10.48
11 p. m	10.48
11.30 p. m	10.78
12 midnight	10.62

Date.	Discharge.
Sept. 16, 1898:	*Sec.-feet.*
12.30 a. m	10.78
1 a. m	11.08
1.30 a. m	11.08
2 a. m	11.08
2.30 a. m	11.26
3 a. m	11.26
3.30 a. m	11.26
4 a. m	11.26
4.30 a. m	11.26
5 a. m	11.42
5.30 a. m	11.26
6 a. m	11.42
6.30 a. m	11.42
12-hour mean	10.72
Sept. 16, 1898:	
7 a. m	11.26
7.30 a. m	11.26
8 a. m	10.94
8.30 a. m	11.08
9 a. m	11.08
9.30 a. m	10.78
10 a. m	10.48
10.30 a. m	10.48
11 a. m	10.32
11.30 a. m	10.16
12 m	10.00
12.30 p. m	9.84
1 p. m	9.68
1.30 p. m	9.54
2 p. m	9.40
2.30 p. m	9.24
3 p. m	9.10
3.30 p. m	9.24
4 p. m	8.94
4.30 p. m	8.94
5 p. m	8.94
5.30 p. m	8.94

Discharge measurements of Mill Creek at Mountain Home, etc.—Continued.

Date.	Discharge.
Sept. 16, 1898:	*Sec.-feet.*
6 p. m	9.08
6.30 p. m	9.40
12-hour mean	9.92
Sept. 16, 1898:	
7 p. m	9.54
7.30 p. m	9.68
8 p. m	9.68
8.30 p. m	9.84
9 p. m	9.84
9.30 p. m	9.84
10 p. m	10.16
10.30 p. m	10.16
11 p. m	10.32
11.30 p. m	10.32
12 midnight	10.32
Sept. 17, 1898:	*Sec.-feet.*
12.30 a. m	10.48
1 a. m	10.48
1.30 a. m	10.64
2 a. m	10.78
2.30 a. m	10.78
3 a. m	10.78
3.30 a. m	10.78
4 a. m	10.78
4.30 a. m	11.08
5 a. m	11.08
5.30 a. m	11.08
6 a. m	11.26
6.30 a. m	11.26
12-hour mean	10.46

Discharge measurements of Mill Creek, San Bernardino County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 15, 1899	S. G. Bennett	8.9	Redlands Power Co., lower intake.[a]
Oct. 2, 1900	W. W. Cockins, jr	7.3	Do.

[a] Loss from this intake to head of Crafton Canal, 1.46 second-feet.

Estimated monthly discharge of Mill Creek at Crafton Canal headworks.

[Drainage area, 47 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
August	27.6	24.0	24.5	1,505	0.52	0.60
September	26.5	19.5	22.0	1,310	.47	.52
October	24.5	17.0	19.6	1,205	.42	.48
1896.						
May	21.4	9.4	13.4	825	.28	.33
June	16.0	5.1	10.3	615	.22	.25
July	16.0	6.1	11.5	709	.24	.28
August	13.2	8.7	11.6	716	.25	.28
September	15.0	7.4	11.5	687	.24	.27
October	13.1	9.0	10.5	637	.22	.26
1899.						
February	13.0	11.0	11.6	644	.25	.26
March	16.0	10.0	12.2	750	.26	.30
April	13.0	11.0	11.8	702	.25	.28
May	12.0	10.0	11.2	689	.23	.26
June	17.0	4.0	8.7	518	.19	.21
July	7.2	4.8	5.8	357	.12	.14
August	7.2	2.9	5.8	357	.12	.14
September	5.7	2.0	4.1	244	.09	.10
October	8.5	4.3	6.5	400	.14	.16
November	11.2	6.1	8.6	512	.18	.20
December	14.6	5.3	9.5	584	.20	.23
1900.[a]						
January	10.6	9.8	10.0	615	.22	.25
February	10.6	9.8	10.0	555	.22	.23
March	13.2	9.6	10.0	615	.22	.25
April	13.3	8.9	10.0	595	.22	.24
May	17.0	8.2	12.0	738	.27	.31
June	8.2	5.3	7.0	417	.16	.18
July	6.3	3.3	5.0	307	.11	.13
August	5.7	4.3	5.0	307	.11	.13
September	5.7	4.3	5.0	298	.11	.12
October	5.8	3.8	5.0	307	.11	.13
November 1 to 17	8.5	5.1	5.0	298	.11	.12

[a] Exclusive of pumped water

Estimated monthly discharge of Mill Creek at Crafton Canal headworks—Cont'd.

Month.	Discharge.			Total.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
June 19 to 30	20.9	19.4	20.1	478	.43	.19
July	19.1	13.9	15.9	975	.34	.39
August (23 days)[a]	50.0	15.0	19.1	870	.41	.35
September	16.6	11.4	14.0	835	.30	.33
October	13.2	12.3	12.6	774	.27	.31
November	12.3	11.6	12.3	731	.26	.29
December	12.3	10.3	12.0	738	.26	.30

[a] On August 16 a cloudburst in Mill Creek Canyon and Crafton Hills filled zanje and supply canal with sand. No record from August 16 to 23, inclusive.

MILL CREEK, GREEN SPOT PIPE LINE.

See Santa Ana River, Green Spot pipe line.

MILL CREEK.

See Stanislaus River, Mill Creek.

MILL FLUME AND PUMP, RIVERSIDE WATER COMPANY.

See San Bernardino Valley.

MISSION CREEK.

Discharge measurements of Mission Creek, Santa Barbara County, 200 feet above dam.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Jan. 15, 1888	A. Poett	0.93
Jan. 24, 1888	do	2.80
Feb. 7, 1888	do	1.37
Mar. 16, 1888	do	2.23
July 26, 1888	do	.36
July 13, 1889	do	.43
Aug. —, 1889	G. F. Wright	.46
Sept. 1, 1889	A. Poett	.32
June 11, 1892	do	.36
June 17, 1900	R. Moyer	[a].05

[a] Above diversions, but not on bed rock.

MOHAVE RIVER.

The streams forming the headwaters of this river have their source on the northern slope of the Sierra Madre and flow northerly, the river finally disappearing in the sands of the Mohave Desert. At Victorville, a station on the Atchison, Topeka and Santa Fe Railroad, the river passes through a narrow gorge, locally known as The Narrows. This place has been under investigation as a possible dam site, and soundings for the depth of bed rock were made by the United States Geological Survey during the season of 1899. The greatest depth of bed rock was found to be 54 feet. The diamond drill showed the rock to be a fine-grained granite.[a] Above The Narrows the valley broadens into a large reservoir site, and at the 145-foot flow line is said to cover 7,718 acres. In order to determine the amount of water available for storage for this reservoir, a gaging station was established February 27, 1899. The rod is a 2 by 6 inch timber, bolted to a vertical cliff on the right bank of the river, 600 feet upstream from the wagon bridge. The bench mark is top of east rail of the Santa Fe track, 75 feet south of center of wagon bridge over track. The zero mark of rod is 12.84 feet below bench mark.

Discharge measurements of Mohave River at Victorville Narrows, San Bernardino County.

Date.	Hydrographer.	Gage height.	Discharge.
1899.		*Feet.*	*Sec.-feet.*
Feb. 27	B. Cole	1.0	44
May 5	S. G. Bennett	.9	33
June 13	do	.9	31
July 26	do	.85	27
Sept. 5	do	.85	28
1900.			
Apr. 13	do	.9	36
Apr. 28	P. H. Leahy	.9	42
May 11	do	.9	36
May 23	do	.9	34
May 29	do	.9	26
June 3	do	.9	24
June 20	do	.85	29
July 6	do	.85	31
July 25	do	.85	28

[a] Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 4, 1901, p. 472.

Discharge measurements of Mohave River at Victorville Narrows, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Feb. 11	S. G. Bennett	1.4	664
Mar. 4	P. H. Leahy	1.3	512
Mar. 25	do	.9	50
Apr. 9	do	.9	39
Apr. 27	do	.9	48
May 10	do	.85	47
May 25	do	.85	51
June 10	do	.85	43
June 25	do	.9	42
July 12	do	.9	40
July 28	do	.9	42
Aug. 8	do	.9	45
Aug. 31	do	.9	55
Sept. 6	do	.9	49
Sept. 20	do	.9	61
Oct. 5	do	.9	57
Oct. 24	do	.9	82
Nov. 6	do	.9	78
Nov. 24	do	.9	76
Dec. 10	do	.9	76
Dec. 25	do	.9	69
1902.			
Jan. 4	do	.9	47
Jan. 21	do	.9	53
Feb. 1	do	.9	58
Feb. 25	do	.9	63
Mar. 5	do	.9	66
Mar. 29	do	.9	66
Apr. 5	do	.9	67
Apr. 19	do	.9	62
Apr. 26	do		47
May 10	do		37
May 25	do		49
June 8	do		53
June 27	do		47
July 5	do		38
July 26	do		41
Aug. 9	do		48
Aug. 15	do		33
Oct. 20	do		49
Oct. 30	do		45
Nov. 10	do		43
Nov. 27	do		50
Dec. 11	do		68
Dec. 19	do		69
Dec. 27	S. G. Bennett		55

Estimated monthly discharge of Mohave River at Victorville.

[Drainage area 400 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January						
February						
March	60	28	37	2,275	0.09	0.10
April	60	28	37	2,202	.09	.10
May	44	28	33	2,029	.08	.09
June	44	28	29	1,726	.07	.08
July	28	22	27	1,660	.07	.08
August	28	17	24	1,476	.06	.07
September	22	22	22	1,309	.05	.06
October	28	17	23	1,414	.06	.07
November	44	22	27	1,607	.07	.08
December 1 to 13	28	28	28	1,722	.07	.08
1900.						
January	44	44	44	2,705	.11	.13
February	60	44	49	2,721	.12	.12
March	80	44	57	3,505	.14	.16
April	44	33	35	2,083	.09	.10
May	33	33	33	2,029	.08	.09
June	33	25	30	1,785	.08	.09
July	29	25	26	1,599	.06	.07
August	29	29	29	1,783	.07	.08
September	29	29	29	1,726	.07	.08
October	33	29	32	1,968	.08	.09
November	3,200	33	139	8,271	.35	.39
December	33	33	33	2,029	.08	.09
The year	3,200	25	45	32,204	.11	1.49

Estimated monthly discharge of Mohave River at Victorville—Continued.

Month.	Discharge.			Run-off.		
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	4,180	50	183	11,252	0.46	0.53
February	4,820	50	925	51,372	2.31	2.41
March	660	50	178	10,945	.45	.52
April	44	44	44	2,618	.11	.12
May	49	49	49	3,013	.12	.14
June	42	42	42	2,499	.11	.12
July	40	40	40	2,460	.10	.12
August	50	50	50	3,074	.13	.15
September	55	55	55	3,273	.14	.16
October	69	69	69	4,243	.17	.20
November	77	77	77	4,582	.19	.21
December	73	73	73	4,489	.18	.21
The year	4,820	40	149	103,820	.37	4.89
1902.						
January	53	47	50	3,074	.13	.15
February	63	58	60	3,332	.15	.16
March	66	66	66	4,058	.17	.20
April	67	47	59	3,511	.15	.17
May	49	37	43	2,644	.11	.13
June	53	47	50	2,975	.13	.14
July	41	38	40	2,460	.10	.12
August	48	33	40	2,460	.10	.12
September	([a])	([a])	([a])	2,618	.11	.12
October	49	45	47	2,890	.12	.14
November	50	43	46	2,737	.12	.13
December	69	55	65	3,997	.16	.18
The year	69	33	51	36,756	.13	1.76

[a] Estimated.

MOKELUMNE RIVER.

The Mokelumne River drains 537 square miles of the western slopes of the Sierra Nevada above Electra, Cal. A gaging station was established at this point by Burr Bassell, C. E., while employed by the Standard Electric Company. Daily gage readings were taken from January 1 to June 30, 1901, and numerous meter measurements were made.

Discharge measurements of Mokelumne River, Amador County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality
1900.		*Feet.*	*Second-feet.*	
Sept. 12	S. G. Bennett	.....	37	Amador ditch at Camp Tabeaud.[a]
Sept. 12	do	.....	4.8	Butte ditch above Electra.
1901.				
Jan. 8	B. Bassell	5.9	1,717	Electra.
Feb. 4	do	4.2	608	Do.
Feb. 15	do	4.8	966	Do.
Feb. 19	do	11.0	13,213	Do.
Feb. 22	do	8.6	6,330	Do.
Feb. 26	do	7.4	3,846	Do.
Mar. 4	do	6.6	2,723	Do.
May 3	do	6.2	2,232	Do.
May 21	do	6.7	3,016	Do.
1902.				
Aug. 14	E. T. Perkins	.....	51	Do.
Aug. 14	do	.....	30	Electra power plant discharge.
	Total	.....	81	
1895.				
Jan. 6	J. B. Lippincott	12.25	1,063	Lodi.[b]
Mar. 20	do	8.0	1,068	Do.
Aug. 27	do	1.3	91	Do.
1899.				
Aug. 20	do	.....	56	Do.
Sept. 14	S. G. Bennett	.....	33	Mokelumne Hill.

[a] Capacity of ditch, 64 second-feet; 25 second-feet carried out of basin to Jackson and Sutter Authority, Burr Bassell.

[b] The Woodbridge diversion dam, 2 miles below Lodi, affects gage heights.

Discharge measurements of Mokelumne River, Amador County—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
1900.		*Feet.*	*Sec.-feet.*	
Sept. 12	S. G. Bennett		15	Mokelumne Hill.
1902.				
Aug. 12	do	2.8	40	Woodbridge Canal at head.
Aug. 16	L. Lawson	3.0	29	Do.
Aug. 12	S. G. Bennett		33	At Woodbridge.
Aug. 13	do	1.0	67	¼ mile below Lancha Plana dam.
Aug. 14	E. T. Perkins		51	Amador ditch, ¼ mile above tunnel.
Aug. 14	do		53	Standard Power Canal at flume No. 59, near Electra.
Aug. 15	do		21	Mokelumne ditch in flume, South Fork Mokelumne River.
Aug. 15	do		1.7	Middle Fork, 150 feet below bridge near West Point.
Aug. 15	do		61	North Fork, ½ mile above bridge near West Point.
Aug. 16	do		4.8	Mokelumne ditch, 2 miles southeast Fort Mountain, South Fork.
Aug. 14	L. Lawson		65	Clements.
Aug. 15	do		126	¼ mile below Lancha Plana dam.

Estimated monthly discharge of Mokelumne River at Lone Star Mills.[a]

[Drainage area 657 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November[b]			33	1,964	0.05	0.06
December[b]			33	2,029	.05	.06
1879.						
January[b]	2,107		328	20,168	.50	.58
February	7,575	134	1,198	66,534	1.82	1.89
March	3,420	676	1,369	84,177	2.08	2.40
April	5,072	1,579	3,065	182,380	4.67	5.21
May	6,170	1,348	3,247	199,650	4.94	5.69
June	5,610	1,579	3,629	215,941	5.52	6.16
July	1,117	288	538	33,080	.82	.95
August[b]			164	10,084	.25	.29
September[b]			26	1,547	.04	.04
October[b]			19	1,168	.03	.03
November[b]			59	3,511	.09	.10
December	624	224	465	28,592	.71	.82
The year			1,175	846,832	1.79	24.16
1880.						
January	288	256	279	17,155	.42	.48
February	520	288	396	22,778	.60	.65
March	728	520	644	39,598	.98	1.13
April	9,642	728	4,553	270,922	6.93	7.73
May	8,071	3,048	5,031	309,344	7.66	8.83
June	7,326	4,685	6,054	360,238	9.21	10.27
July	5,201	572	2,745	168,783	4.18	4.82
August	480	134	365	22,443	.55	.63
September	134		29	1,726	.04	.04
October[b]			164	10,084	.25	.29
November[b]			98	5,831	.15	.17
December	998		291	17,893	.44	.51
The year			1,721	1,246,795	2.61	35.55

[a] Authority, California State engineering department.

[b] Estimated from run-off of neighboring streams and from previous measurements.

Estimated monthly discharge of Mokelumne River at Lone Star Mills—Cont'd.

Month.	Discharge.			Run-off.		
	Maximum.	Minimum.	Mean.	Total discharge.	Per square mile.	Depth.
1881.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	8,536	192	1,037	63,763	1.58	1.82
February	8,852	624	3,049	169,333	4.64	4.83
March	2,701	728	1,126	69,235	1.71	1.97
April	4,556	1,810	3,195	190,116	4.86	5.42
May	4,298	1,579	3,034	186,553	4.62	5.32
June	2,701	572	1,237	73,607	1.88	2.10
July	520		159	9,777	.24	.28
August [a]			98	6,026	.15	.17
September [a]			98	5,831	.15	.17
October [a]			66	4,058	.10	.12
November [a]			207	12,317	.32	.36
December [a]			624	38,368	.95	1.10
The year			1,160	828,984	1.77	23.66
1882. [a]						
January			591	36,339	.90	1.04
February			624	34,655	.95	.99
March			1,971	121,192	3.00	3.46
April			2,628	156,377	4.00	4.46
May			4,927	302,949	7.50	8.65
June			3,285	195,471	5.00	5.58
July			788	48,452	1.20	1.38
August			66	4,058	.10	.12
September			59	3,511	.09	.10
October			230	14,142	.35	.40
November			207	12,317	.31	.35
December			207	12,728	.31	.36
The year			1,298	942,191	1.98	26.89

[a] Estimated from run-off of neighboring streams and from previous measurements

Estimated monthly discharge of Mokelumne River at Lone Star Mills—Cont'd.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			414	25,456	0.63	0.73
February			328	18,216	.50	.52
March			591	36,339	.90	1.04
April			1,971	117,283	3.00	3.35
May			3,942	242,384	6.00	6.92
June			2,628	156,377	4.00	4.46
July			657	40,397	1.00	1.15
August			263	16,171	.40	.46
September			98	5,831	.15	.17
October			98	6,026	.15	.17
November			132	7,855	.20	.22
December			132	8,116	.20	.23
The year			938	680,451	1.43	19.42
1884.[a]						
January			164	10,084	.25	.29
February			1,971	113,373	3.00	3.24
March			3,942	242,384	6.00	6.92
April			3,942	234,565	6.00	6.69
May			3,285	201,987	5.00	5.76
June			2,957	175,954	4.50	5.02
July			2,628	161,589	4.00	4.61
August			657	40,397	1.00	1.15
September			131	7,795	.20	.22
October			98	6,026	.15	.17

[a] Estimated from run-off of neighboring streams and from previous measurements.

Estimated monthly discharge of Mokelumne River at Electra.[a]

[Drainage area, 537 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
	Sec.-feet.	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
1901.						
January	4,600	330	1,000	61,488	1.86	2.14
February	13,210	610	3,302	183,384	6.15	6.40
March	4,020	1,130	2,004	123,221	3.73	4.30
April	3,160	950	2,040	121,388	3.80	4.24
May	9,980	1,960	4,627	284,503	8.62	9.93
June	6,790	1,350	3,833	228,145	7.14	7.97
July			260	15,987	.48	.55
August			190	11,683	.35	.40
September			60	3,570	.11	.12
October			76	4,673	.14	.16
November			210	12,496	.39	.44

[a] Authority, United States Geological Survey.

MONO LAKE DRAINAGE.

Discharge measurements in Mono Lake drainage basin, Mono County, Cal.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 29, 1902	F. H. Olmsted	46.72	Mill Creek, just below Lundy Lake and above all diversions.
July 30, 1902	do	89.00	Leevining, just above Rhinedollar Lake.
Aug. 1, 1902	do	26.36	Walker Creek, easterly from Bloody Canyon.
Do	do	21.65	Parker Creek.
Do	do	62.40	Rush Creek, above Silver Lake.

NIAGARA CREEK.

See Stanislaus River, Niagara Creek.

OWENS RIVER.

Discharge measurements of Owens River, Inyo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. 4, 1902	F. H. Olmsted	26.87	Mammoth Creek at sawmill.
Do	do	37.14	Convict Creek near crossing of Bishop road.

PACOIMA CANYON.

See Los Angeles River, Pacoima.

PADARO CREEK.

Discharge measurement of Padaro Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Aug. 1899	G. F. Wright	0.31

PALLETT CREEK.

See Big Rock Creek, Pallett Creek.

PASADENA MESA.

UNDERGROUND WATER OBTAINED FROM THE BED OF ARROYO SECO AND PASADENA MESA.

An examination of the underground water supply in the vicinity of Pasadena was made by Mr. J. B. Lippincott in October, 1898, the results of which are given in the following paragraphs:

Pasadena Mesa, lying south of the Sierra Madre, is bounded on the west, along the eastern bank of Arroyo Seco, by a low range of granite and clay hills; on the south by Raymond Hill, which is of sandstone, and by a dike, the capping of which apparently consists of adobe or clay. This dike extends from Raymond Hill, on the south side of the city of Pasadena, in a direction a little north of east, through Sunny Slope and Baldwin ranches to the base of the Sierra Madre near the mouth of Santa Anita Canyon. The mesa proper consists of deposits of sand, gravel, and bowlders, the larger bowlders lying near the mountains and the finer material near the southern slope. The voids in this absorbent material act as a storage reservoir, being filled by the flood waters issuing from the steep slopes on the southern face of the Sierra Madre. The underground waters are reenforced by the return water from irrigation on the mesa. From 1893 to 1902, inclusive, was a period of unusual drought, but most of the developments were new in 1898.

Arroyo Seco, draining 21 square miles of the Sierra Madre, issues from these mountains on the north side of Pasadena Mesa, passes through an opening in a granite spur known as Devils Gate, and joins Los Angeles River at Los Angeles. Between the point where the water from this basin issues from the mountains and Devils Gate lies a broad river bottom 2 miles in length, composed of coarse material. In passing over this the water sinks rapidly, diminishing in volume from the mouth of the canyon to Devils Gate.

Pasadena water companies have built extensive development tunnels above Devils Gate, cross cutting beneath the eastern bank and under the mesa land. A submerged dam at Devils Gate assists the tunnel developments by intercepting the underflow. An examination of these tunnels shows that no impervious stratum is encountered after the granite ledge at Devils Gate is passed. Of the water obtained from these development works, 69 per cent is gained from the portion of the tunnel which is beneath the mesa. A well about

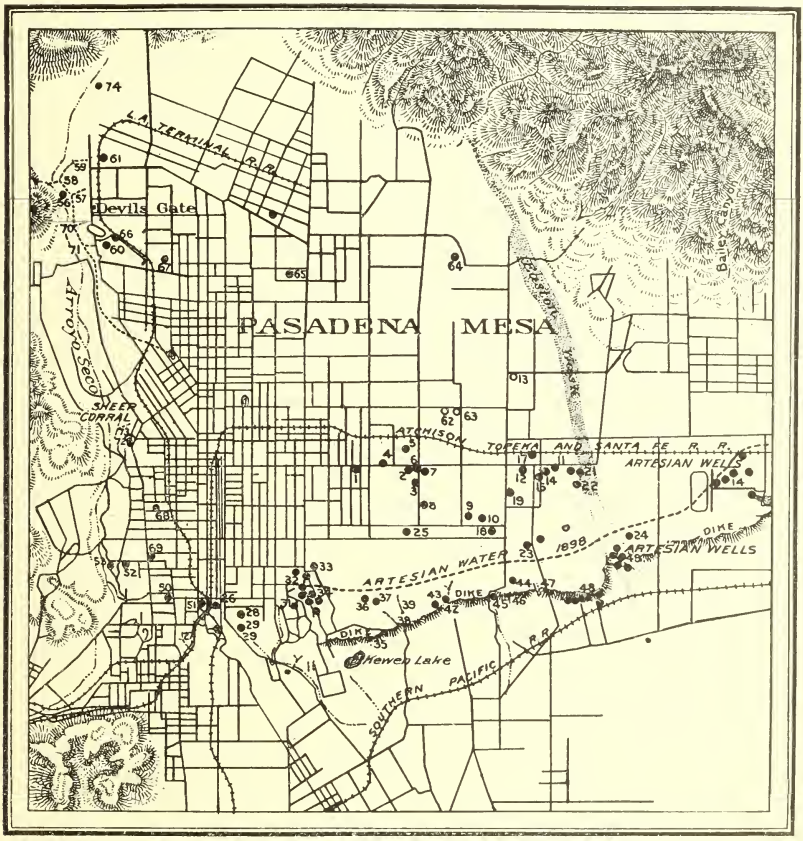

FIG. 3.—Map showing location of wells near Pasadena.

4,000 feet upstream from the tunnel and 200 feet deep, in the bed of the wash near the mouth of the mountain canyon of the Arroyo Seco, was drained by the extension of this line of tunnels under Pasadena Mesa.

From the investigations the conclusion is reached that the water from Arroyo Seco which sinks between the mouth of the canyon proper and Devils Gate passes under the eastern bank of Arroyo Seco between these points and augments the underground water of

Pasadena Mesa. Otherwise it would be difficult to account for the large amount of water which is obtained from the lower development works at the southern dike of Pasadena Mesa. This mesa is underlain throughout with a sheet of water extending from the foot of the mountains, where its depth below the surface is from 150 to 200 feet, to the dike at its southern exposure, where the water is practically at the surface, making itself manifest in numerous small springs which rise in drainage lines on the southern face of the dike. With the exception of the Arroyo Seco developments, which in the tabulations are classified by themselves, the principal water product of this mesa is obtained along these drainage lines from the springs. Numerous wells from which water is pumped have been sunk and tunnels have been run through the dike into the water-bearing gravel.

An interesting feature of these development works is the constant strife existing between the various tunnel and well owners along the dike. For instance, the owner of a certain piece of property discovered by a tunnel the presence of a considerable body of water on his land; his neighbor to the south, whose land is at a lower elevation, drained the first tunnel by digging another on a lower grade and extending it to his northern property line. This has been done repeatedly, in some cases the water having been so diverted by two or three owners in succession.

The wells are usually bored and are lined with 7-inch casing. South of the Santa Fe Railroad a charge of 50 cents a foot is made for completing the first 50 feet in depth of the well, with an increase of 50 cents per foot for each additional 50 feet in depth. North of the railroad, where the bowlders are larger, a charge of from 10 to 20 per cent more is made for boring. These prices do not include the cost of casing. The data given below concerning depth of wells and depth of water were in nearly all cases obtained from statements made by the owners.

On the following pages is given a compilation of facts with reference to the depth of water in wells through the district and a summary of the water crop from the principal development works. It has been impossible to form an exact estimate of the amount of water taken for domestic use and for minor irrigation purposes from the large number of small wells on the mesa, but the water from the larger developments has been accurately measured and included in this summary.

DESCRIPTION OF WELLS IN PASADENA MESA.[a]

1. Gidding; on Colorado street between Hollister and Chester streets; elevation, 815 feet; depth to water, 103 feet; dug mostly through gravel with no hardpan; digging cost $1 per foot and 25 cents extra for every 25 feet additional; 109 feet deep, with 6 feet of water; elevation of water, 712 feet.

[a] The unit of measurement is the California miner's inch, which is 0.02 of 1 cubic foot per second.

2. McCallum; Colorado street, in McCallum wash; elevation, 785 feet; 151 feet deep; was dug originally 83 feet; at 90 feet sandstone for 10 feet; 101 feet from surface to water; 50 feet of water; elevation of water, 684 feet; water raised by windmill.

3. Hoover; a bored well with windmill; 115 feet deep, with 17 feet of water; elevation, 775 feet; water elevation, 677 feet.

4. Moses; bored well; 200 feet deep; elevation 790 feet; water elevation, 684 feet; originally 100 feet of water, now 94 feet, commencing 106 feet from the surface; 1½-horsepower gasoline engine with 8-inch stroke, 3-inch cylinder, pumping 1,000 gallons an hour.

5. King; 227 feet deep; elevation, 800 feet; water elevation, 678 feet; originally 117 feet of water, now about 105 feet; water raised by an engine with 12-inch stroke and 4-inch cylinder, pumping 2,500 gallons per hour.

6. Stevens; 121 feet deep; 31 feet of water; 90 feet to water surface; elevation, 781 feet; water elevation, 691 feet; was dug thirteen years ago.

7. McAdam; 150 feet deep; 57 feet from surface to water; elevation, 740 feet; water elevation, 683 feet.

8. Merwin; 95 feet deep; 55 feet to water; elevation, 735 feet; water elevation, 680 feet; pump capacity, 20 gallons per minute; costs 3½ to 4 cents an hour to run engine with gasoline.

9. Butler; bored well; 93 feet deep; 48 feet from surface to water, originally 40 feet; elevation, 718 feet; water elevation, 670 feet.

10. Hutchinson; bored well; 230 feet deep; 36 feet from surface to water; elevation, 713 feet; water elevation, 677 feet; well bored through clay; pressure comes from below.

11. Daniels; 107 feet deep; 40 feet from surface to water; water 67 feet deep; elevation, 715 feet; water elevation, 675 feet; strata of clay and bowlders with coarse gravel at bottom were encountered.

12. Hodge; 169 feet deep; 33 feet to water; elevation, 725 feet; water elevation, 692 feet.

13. Miles; bored well; 225 feet deep; 143 feet to water; elevation, 817 feet; water elevation, 674 feet.

14. Wilkeson; 177 feet deep; 30 feet from surface to water; elevation, 720 feet; water elevation, 690 feet; Jack Butler, well borer, says that wells during 1898 were 15 feet lower than in previous years.

15. Ackerman; bored well; 149 feet deep; 75 feet from surface to water; elevation, 710 feet; water elevation, 635 feet.

16. Thorndyke; 275 feet deep; 30 feet from surface to water; elevation, 705 feet; water elevation, 675 feet; fine clay encountered at 69 feet and 73 feet from surface, the remainder being gravel strata.

17. Lamanda Park; 180 feet deep; originally 80 feet from surface to water; elevation, 740 feet; present water elevation, 680 feet.

18. Titus; 558 feet deep; from surface to water, 12 feet, originally 4 feet; elevation, 690 feet; water elevation, 678; several strata of cement 1 inch thick were encountered.

19. Butler; 175 feet deep; 75 feet from surface to water; elevation, 720 feet; water elevation, 645 feet.

20. Graves; 88 feet deep; 40 feet from surface to water; elevation, 720 feet; water elevation, 680 feet.

21. Krouser; 113 feet deep; 15 feet from surface to water; elevation, 700 feet; water elevation, 685 feet.

22. Wakefield; 60 feet deep; originally 20 feet to water, now 30 feet; elevation, 703 feet; water elevation, 673 feet.

23. Pavey; 360 feet deep; water elevation, 670 feet; originally flowed 16 miner's inches of water; still flowing, but in less volume.

24. Chapman; flowing well; 175 feet deep. There are about 12 wells flowing on this ranch.

25. Hassleys; 500 feet deep; elevation, 600 feet; originally artesian, but now cut by a tunnel at a lower elevation.

26. Raymond; 40 feet to water, which is 4 feet deep; water fell 2 feet during season of 1898; 91 miner's inches of water were pumped from this well during October, 1898; well is brick lined and 12 feet in diameter.

27. Marengo tunnel; run into Raymond's hill at Terminal Railway, Fair Oaks station; it is discharging 18 miner's inches. This tunnel drained a small tunnel on the west side of Fair Oaks avenue.

28. Fluer; dug well, Ipswich street; depth, 48 feet; water, 12 feet; dug in October, 1897; at first there was a supply of 50 miner's inches, but the supply has diminished to 30 miner's inches; a 6-inch centrifugal pump, with 20-horsepower engine, pumps out the well in 1.5 hours.

29. Stoneman tunnel; was first run in 1892, 178 feet, and in summer of 1898 was extended 164 feet; flows 14.4 miner's inches.

30. Graves tunnel; 530 feet of tunnel and about 100 feet of ditch; water 26 feet below the surface of the ground at the upper end; 20 miner's inches of water obtained.

31. Oak Knoll; about the same class as Rhodes well and discharging the same amount of water, 4 miner's inches.

32. Brickyard well; near Lake avenue, northeast from Oak Knoll; 40 feet of well are through clay, 7 feet through sand and gravel; 7 miner's inches of water is obtained; this is a brick-lined dug well.

33. Rhodes well; near corner of Lake avenue and Hawkeye street; 49 feet deep and water approximately 8 feet in depth; steam plant, 15-horsepower boiler, with Smith valve pump; a continuous flow of 4 miner's inches is obtained.

34. Alhambra water, in Mayberry Canyon; 64 miner's inches is obtained, which is not the full capacity of the plant. There are six wells, from 350 to 750 feet deep, of which five are being pumped and one flows.

35. Patton tunnel, near Kewen Lake; produces 7 miner's inches.

36. Surface water; Patton water in West Canyon, 2 miner's inches.

37. Patton water, East Canyon; 24 miner's inches. (San Gabriel water not included in this.)

38. San Gabriel Mission; 24.9 miner's inches; comes from the same canyon as Patton water in East Canyon; it is surface water and has been reduced by development works.

39. Shorb water; from tunnel under orange grove on Shorb place; approximately 2 miner's inches is obtained. In small canyon northwest of house there is a stream, approximately 5 miner's inches; there are three artesian wells (No. 42) southeast of the ranch house, from which 17 miner's inches is obtained.

60. Lower Painter well; dug in 1894; 96 feet deep; water, 79 feet from surface; elevation, 1,040 feet; water elevation, 961 feet; this is a 4-foot by 7-foot dug well, the material passed through being large bowlders.

61. Upper Painter well; dug well much resembling No. 60; 162 feet deep; 132 feet to water; elevation, 1,129 feet; water elevation, 997 feet.

62. Becker; 200 feet deep; depth to water, as measured in May, 1898, 173 feet; a 6-horsepower gasoline engine is used which has pumped 5 miner's inches; it is a bored well; cost $250, including casing ($1 per foot plus 25 cents additional for each 50 feet additional depth); elevation, 825 feet; water elevation, 652 feet.

63. Stafford; bored well; 241 feet deep; depth to water, 173 feet; elevation, 825 feet; water elevation, 652 feet.

64. Krank; 300 feet deep; 290 feet to water; elevation, 1,070 feet; water elevation, 780 feet.

65. Meers; on E street; 300 feet deep; 75 feet of water in August, 1897; elevation, 1,060 feet; water elevation, 835 feet.

66. Stone; 100 feet deep; 85 feet to water; elevation, 1,040 feet; water elevation, 955 feet; approximately 15 miner's inches is obtained when pump is run. This is a dug and timbered well and cost for excavation $1.75 per vertical foot until water was struck; passed through, say, 65 feet of gravel, 15 feet of sand, and 12 feet of clay.

67. Called Painter well; 170 feet to water; 14 feet lower ground than No. 41; water elevation, 830 feet.

50. Hurlbut; bored well, about 1,300 feet deep; 95 feet through clay; but little water; elevation, 816 feet; water elevation, 745 feet.

26. Olmsted; 39 feet deep; elevation, 750 feet; water elevation, 740 feet; the usual depth of water from the surface is 8 feet, but in October, 1898, was 10.5 feet.

51. Pasadena and Pacific power-house well; elevation, 750 feet; water stands 11 feet from original surface of ground; water elevation, 739 feet.

52. Baker; 35 feet deep; elevation, 740 feet; water elevation, 734 feet; supply is said to come from northeast.

53. Pasadena West Side Water Company; about 70 feet deep and 3 feet to water; elevation, 718 feet; water elevation, 715 feet; water comes from northeast.

68. Morehouse; cesspool at this point of 70 feet and no water is encountered; surface elevation, 790 feet.

69. On top of a hill 500 feet east of No. 53; 60 feet deep and no water found; surface elevation, 825 feet.

74. In Arroyo Seco, at mouth of canyon; 250 feet deep and dry.

Amount of water developed in Pasadena Mesa, October, 1898.

[1 miner's inch is 0.02 of 1 cubic foot per second.]

	Miner's inches.
27. Raymond Improvement Company's tunnel at Fair Oaks avenue	18
26. Marengo well, near Atchison, Topeka and Santa Fe station, Raymond	91
26. Surface water in Marengo Canyon, near railroad crossing (Southern Pacific)	20
28. Fluer well on Ipswich street, near Santa Fe Raymond station; intermittent pumping	30
29. Las Roebles Water Company, near new Graves tunnel	14
29. Stoneman Canyon heads, near Fluer well	3
30. Walter Graves's new or upper tunnel	20
31. Oak Knoll well	4
32. Brickkiln well	7
33. C. H. Rhodes's well, near Lake avenue and Hawkeye street	4
34. Alhambra water, artesian wells and air-compressing plant	64
35. Patton tunnel, near Kewen Lake	7
36. Patton water in west canyon	2
37. Patton water from east canyon	24
38. San Gabriel Mission water	25
39. Shorb water northwest from ranch house	5
39a. Shorb water in tunnel southwest of ranch house	2
40. Graves's lower tunnel (dry)	0
41. Richardson's two tunnels, near Kewin Lake	18
42. Shorb's three artesian wells southeast of house	17
43. Pump, 13 inches; artesian, 3 inches; tunnel, 22 inches; all belong to Shorb	38

	Miner's inches.
44. Rose well, east side Santa Anita avenue	20
45. Winston wells, Santa Anita avenue	12
46. Alexander water, east of Santa Anita avenue	25
47. Titus ranch	19
48. Sunny Slope developments	66
59. Chapman	106
Total	661

Developments near Devils Gate by the United Water Companies.

56. Pumped from well below Devils Gate, but entering tunnel above sand box	7
57. Weir at mouth of northeast tunnel	8
58. Weir at mouth of northwest tunnel	123
Total from Devils Gate	138
59. Total from North Branch	118
Total from submerged dam and from under arroyo above dam	5
Flow from the 900-foot tunnel, east bank of arroyo, or six-tenths of whole Devils Gate flow from tunnels	77
70. Richardson tunnel below Devils Gate	24
71. Wilson tunnel below Devils Gate	10
Developed at Devils Gate	138
Total upper arroyo development	172
42. Upper Painter well	37
41. Lower Painter well	40
48. Stone well	15
Pump near reservoir No. 1	22
Total	114
72. Sheep Corral Springs, in development cut	74
73. Above shaft No. 2, detail of No. 58	22

Summary of water development from Pasadena Mesa.

Devils Gate development	172
Sheep corral	74
Lower dike in 4½ miles	661
Total	907

PASTORIA CREEK.

Discharge measurement of Pastoria Creek, Kern County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Nov. 13, 1895	J. B. Lippincott	0.04	Mouth of canyon.
Dec. 15, 1896	do	0.00	Road crossing.

PESCADERO CREEK.

Discharge measurement of Pescadero Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Oct. 17, 1893	W. W. Brier	4.67	6 miles above Pescadero.

PILARCITOS CREEK.

Discharge measurement of Pilarcitos Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Oct. 17, 1893	W. W. Brier	0.80	3½ miles above Half Moon Bay.

PIRU CREEK.

Discharge measurements of Piru Creek, Ventura County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Mar. 10, 1895	J. B. Lippincott	0.27	3.54	Robertson Mill.
Jan. 21, 1896	S. Stewart		18.00	Smith's.
Jan. 31, 1896	J. B. Lippincott	1.75	13.30	Do.
Aug. 11, 1898	F. H. Olmsted		0.92	French House.
Dec. 15, 1896	J. B. Lippincott		.20	Gorman Creek below Gorman Station.
Mar. 16, 1899	S. G. Bennett		[a] 61.00	At Piru City, wagon road crossing.
Mar. 17, 1899	do		[a] 152.00	Do.
Mar. 14, 1899	do		5.00	Narrows, near Dutton's.
Aug. 19, 1899	do		1.30	Head of Piru pipe line.
Oct. 8, 1900	W. W. Cockins, jr		2.20	Lower Piru Creek, ditches from.

[a] Ditch is carrying 10 second-feet on both dates in addition.

PIT RIVER.

Discharge measurements of Pit River, Shasta County.

Date.	Hydrographer.	Discharge.	Locality.
1901.		*Sec.-feet.*	
Sept. —	Robt. McF. Doble	2,230	Peck's Bridge.
Sept. 9	S. G. Bennett	2,682	Silverthorn Ferry.
Sept. —	Robt. McF. Doble	177	Burney Creek, tributary of Pit River.
Sept. —	do	1,447	Fall River, near mouth.
Sept. —	do	627	Hat Creek, Carbon bridge.
Sept. 9	S. G. Bennett	23	Squaw Creek, near Copper City bridge.
1902.			
Sept. 17	do	208	Pit River above mouth of Fall River, at Fall River Mills.
Sept. 16	do	1,543	Fall River, at bridge.
Do	do	583	Hat Creek, at Carbon bridge.
Sept. 15	do	2,350	Peck's bridge.
Do	do	209	Burney Creek, ½ mile below Burney Falls.
Sept. 27	Chas. A. Miller	2,508	Silverthorn Ferry.
Do	do	37	Squaw Creek, near Copper City bridge.

PLUNGE CREEK.

Discharge measurements of Plunge Creek, at headworks in canyon, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
June 12, 1898	J. B. Lippincott	2.30
Sept. 9, 1898	do	.20
Mar. 25, 1899	S. G. Bennett	10.90
Aug. 25, 1899	do	.50
July 12, 1900	do	.34
Apr. 7, 1902	do	12.40
Sept. 4, 1902	W. B. Clapp	.37

POMPONIO CREEK.

Discharge measurement of Pomponio Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality
1893.		*Sec.-feet.*	
Oct. 17	W. W. Brier	0.27	2 miles above mouth.

POSO CREEK.

Estimated monthly discharge of Poso Creek at base of foothills.[a]

[Drainage area, 289 square miles.]

Month	Mean discharge.	Total discharge.	Run off.	
			Per square mile.	Depth.
1878.	*Sec.-feet*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	0	0	0	0
December	0	0	0	0
1879.				
January	23	1,414	0.08	0.09
February	40	2,221	.14	.15
March	20	1,230	.07	.08
April	72	4,284	.25	.28
May	52	3,197	.18	.21
June	17	1,012	.06	.07
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	75	4,463	.26	.29
December	145	8,916	.50	.58
The year	37	26,737	13	1.75
1880.				
January	347	21,336	1.20	1.38
February	665	38,251	2.30	2.48
March	751	46,177	2.60	3.00
April	838	49,864	2.90	3.24
May	578	35,540	2.00	2.31
June	145	8,628	.50	.56
July	14	861	.05	.06
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	58	3,451	.20	.22
December	145	8,916	.50	.58
The year	294	213,024	1.02	13.83

[a] Authority, State engineer. Estimated from run-off of neighboring streams.

Estimated monthly discharge of Poso Creek at base of foothills—Continued.

Month	Mean discharge.	Total discharge.	Run-off	
			Per square mile	Depth
1881.[a]	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	145	8,916	0.50	0.58
February	289	16,050	1.00	1.04
March	289	17,770	1.00	1.15
April	289	17,197	1.00	1.12
May	289	17,770	1.00	1.15
June	145	8,628	.50	.56
July				
August				
September				
October				
November	0	0	0	0
December	35	2,152	.12	.14
The year	123	88,483	.42	5.74
1882.[a]				
January	35	2,152	.12	.14
February	43	2,388	.15	.16
March	145	8,916	.50	.58
April	145	8,628	.50	.56
May	29	1,783	.10	.12
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	43	2,559	.15	.17
December	14	861	.05	.06
The year	38	27,287	.13	1.79

[a] Estimated from run-off of neighboring stream.

Estimated monthly discharge of Poso Creek at base of foothills—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	43	2,644	0.15	0.17
February	43	2,388	.15	.16
March	231	14,204	.80	.92
April	145	8,628	.50	.56
May	119	7,317	.41	.47
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	29	1,783	.10	.12
November	29	1,726	.10	.11
December	43	2,644	.15	.17
The year	57	41,334	.19	2.68
1884.[a]				
January	145	8,916	.50	.58
February	867	49,870	3.00	3.24
March	867	53,310	3.00	3.46
April	578	34,393	2.00	2.23
May	119	7,317	.41	.47
June	145	8,628	.50	.56
July	0	.....	0	0
August	0	.....	0	0
September	0	.....	0	0
October	0	.....	0	0

[a] Estimated from run-off of neighboring stream.

PURISSIMA CREEK.

Discharge measurement of Purissima Creek, San Mateo County.

Date	Hydrographer.	Discharge.	Locality.
1893.		*Sec.-feet.*	
Oct. 17	W. W. Brier	2.03	1½ miles above Purissima.

PUTAH CREEK.

Discharge measurement of Putah Creek, Napa County.

Date.	Hydrographer.	Discharge.	Remarks.
1900.		*Sec.-feet.*	
Sept. 23	S. G. Bennett	4.4	6 miles above Winters, at Devils Gate.

RABEL DAM DITCH, SAN BERNARDINO COUNTY.

See San Bernardino Valley, Rabel dam ditch.

RANCHERO DITCH, SAN BERNARDINO COUNTY.

See San Bernardino Valley, Ranchero ditch.

RED HILLS DEVELOPMENTS.

See Cucamonga Creek, Red Hills.

REDLANDS CANAL.

See Santa Ana River, Redlands canal.

RINCON CREEK.

Discharge measurements of Rincon Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Aug. —, 1889	G. F. Wright	0.12
June 16, 1900	R. Moyer	.03

RUBICON RIVER.

See Middle Fork American River.

RIVERSIDE WATER COMPANY, UPPER CANAL.

See San Bernardino Valley.

SACRAMENTO RIVER.

This river rises in the extreme northeastern corner of California and flows in a general southerly direction, draining a large area in northern California between the Coast Range on the west and the Sierra Nevada on the east. It discharges into San Francisco Bay. A num-

ber of storage reservoirs have been constructed on the various tributaries of the river, and are used for hydraulic mining purposes and to a less extent for irrigation. The gaging station of the Geological Survey, established April 30, 1895, is located 12 miles above the town of Red Bluff at the crossing of the country road at Jellys Ferry. The gage consists of a vertical rod made in three sections and nailed firmly to trees near the ferry landing. A second rod is located 1,206 feet above the gage, and a third one 350 feet below the main rod, in order to determine the slope of the water surface. The three rods are referred to the same datum. Bench mark No. 1 is on an oak tree on the left bank of the river 300 feet below the cable, and is 22.429 feet above gage datum. The ferry cable is used in the discharge measurements. The channel for 1,000 feet above and below the station is nearly straight. The right bank is high, but the left bank is liable to overflow when the water rises above the 25-foot mark. The bed of the stream consists of gravel and changes only slightly. The gaging station of the State engineering department was at the mouth of the river.

Discharge measurements of Sacramento River.

Date.	Hydrographer.	Discharge.	Locality.
1878.		*Sec.-feet.*	
Oct. —	United States Engineers	6,425	Sacramento.
1879.			
May 12	State engineering department.	16,000	Knights Landing.
July 16	do	7,000	Sacramento Slough.
May 16	do	38,000	Gray & Shaws.
May 21	do	26,000	Above mouth of American River.
July 14	do	13,000	Do.
May 22	do	39,000	Sacramento, foot of I street.
July 14	do	15,000	Do.
Mar. 3	do	40,000	Freeport.
Mar. 20	do	56,000	Do.
Jan. 24	do	12,000	Brannan Slough.

Estimated monthly discharge of Sacramento River at Collinsville.[a]

[Drainage area, 26,187 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1878.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	8,000	476,033	0.31	0.35
December	9,000	553,388	.34	.39
1879.				
January	12,000	737,851	.46	.53
February	30,000	1,666,115	1.14	1.19
March	110,000	6,763,640	4.20	4.84
April	110,000	6,545,450	4.20	4.68
May	75,000	4,611,570	2.86	3.30
June	45,000	2,677,686	1.72	1.92
July	16,000	983,802	.61	.70
August	8,500	522,644	.32	.37
September	6,500	386,776	.25	.28
October	8,000	491,901	.30	.35
November	7,500	446,281	.29	.32
December	27,000	1,660,165	1.03	1.19
The year	37,958	27,493,881	1.45	19.67
1880.				
January	28,000	1,721,653	1.07	1.23
February	21,000	1,207,933	.80	.86
March	22,000	1,352,727	.84	.97
April	95,000	5,652,892	3.63	4.05
May	135,000	8,300,828	5.16	5.94
June	110,000	6,545,450	4.20	4.68
July	53,000	3,258,843	2.02	2.33
August	18,000	1,106,777	.69	.80
September	9,000	535,537	.34	.38
October	7,500	461,157	.29	.33
November	7,000	416,529	.27	.30
December	20,000	1,229,752	.76	.88
The year	43,792	31,790,078	1.67	22.75

[a] Authority, State engineer.

Estimated monthly discharge of Sacramento River at Collinsville—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1881.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	95,000	5,841,322	3.63	4.18
February	115,000	6,386,776	4.39	4.57
March	77,000	4,734,545	2.94	3.39
April	90,000	5,355,372	3.44	3.84
May	70,000	4,304,132	2.67	3.08
June	25,000	1,487,603	.95	1.06
July	14,000	860,826	.53	.61
August	8,000	491,901	.30	.35
September	6,500	386,777	.25	.28
October	7,000	430,413	.27	.31
November	8,200	487,934	.31	.35
December	16,000	983,802	.61	.70
The year	44,308	31,751,403	1.69	22.72
1882.				
January	24,000	1,475,702	.92	1.06
February	22,000	1,221,818	.84	.87
March	55,000	3,381,818	2.10	2.42
April	90,000	5,355,372	3.44	3.84
May	92,000	5,656,859	3.51	4.05
June	74,000	4,403,306	2.82	3.15
July	17,000	1,045,289	.65	.75
August	8,000	491,901	.30	.35
September	6,500	386,777	.25	.28
October	10,000	614,876	.38	.44
November	14,000	833,058	.53	.59
December	11,000	676,364	.42	.48
The year	35,292	25,543,140	1.35	18.28

Estimated monthly discharge of Sacramento River at Collinsville—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1883.	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	12,000	737,851	0.46	0.53
February	17,000	944,132	.65	.68
March	21,000	1,291,240	.80	.92
April	73,000	4,343,801	2.79	3.11
May	80,000	4,919,008	3.05	3.52
June	32,000	1,904,132	1.22	1.36
July	12,000	737,851	.46	.53
August	7,000	430,413	.27	.31
September	6,500	386,776	.25	.28
October	7,000	430,413	.27	.31
November	7,500	446,281	.29	.32
December	7,400	455,008	.28	.32
The year	23,533	17,026,906	.90	12.19
1884.				
January	12,000	737,851	.46	.53
February	24,000	1,380,496	.92	1.01
March	80,000	4,919,008	3.05	3.52
April	105,000	6,247,934	4.01	4.47
May	111,000	6,825,124	4.23	4.88
June	90,000	5,355,372	3.44	3.84
July	31,000	1,906,116	1.18	1.36
August	12,000	737,851	.46	.53
September	7,500	446,281	.29	.32
October	8,000	491,901	.30	.35

Discharge measurements of Sacramento River, Iron Canyon, 4 miles above Red Bluff, Tehama County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Oct. 30	S. G. Bennett	1.02	5,187
Dec. 13	do	2.68	9,651
1902.			
Jan. 28	do	1.35	5,912
Feb. 12	Wm. F. Luning	20.6	[a]110,824
Mar. 3	S. G. Bennett	10.6	41,570
May 10	do	5.5	18,927
Sept. 13	Chas. A. Miller	.84	4,425
Dec. 31	S. G. Bennett	3.20	9,858

[a] Float measurement.

Discharge measurements of Sacramento River at Red Bluff, Tehama County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
1894.		*Feet.*	*Sec.-feet.*
Dec. 20	A. P. Davis and J. B. Lippincott	10.7	45,000
1895.			
Mar. 19	J. B. Lippincott	4.8	15,461
Apr. 27	do	8.4	36,181
1896.			
Jan. 21	do	20.8	109,432
Jan. 22	do	17.7	83,558

Estimated monthly discharge of Sacramento River at Red Bluff, Tehama County.[a]

[Drainage area, 9,356 square miles.][b]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	123,000	15,220	47,267	2,906,320	5.052	5.824
February	65,600	13,860	26,792	1,487,940	2.864	2.982
March	85,360	15,220	32,517	1,999,418	3.475	4.007
April	33,880	26,670	29,566	1,759,300	3.160	3.526
May	48,600	16,840	30,238	1,859,250	3.232	3.726
June	18,600	9,040	12,764	759,510	1.717	1.522
July	9,040	6,150	7,235	444,863	1.364	.892
August	6,150	5,990	6,057	372,436	.647	.746
September	10,820	5,830	6,321	376,106	.676	.754
October	6,285	5,910	5,989	368,261	.640	.738
November	6,690	5,910	6,046	359,792	.646	.711
December	36,880	6,150	10,095	620,760	1.079	1.244
Per annum	123,000	5,830	18,390	13,313,956	1.9656	26.672
1896.						
January	140,000	6,150	51,702	3,179,032	5.53	6.41
February	46,860	9,040	15,231	876,120	1.63	1.76
March	74,050	9,700	25,533	1,569,981	2.73	3.15
April	72,910	16,370	30,708	1,827,271	3.28	3.61
May	81,030	19,660	35,019	2,153,252	3.74	4.35
June	21,150	8,600	13,599	809,215	1.45	1.62
July	8,380	5,990	6,907	424,694	.74	.85
August	5,910	5,660	5,738	352,858	.61	.70
September	5,830	5,660	5,696	338,977	.61	.68
October	6,555	5,660	5,730	352,336	.61	.70
November	57,200	5,660	11,260	670,058	1.20	1.34
December	106,880	11,380	33,316	2,048,546	3.56	4.09
The year	140,000	5,660	20,037	14,602,340	2.14	29.26

[a] Authority, United States Geological Survey.

[b] Drainage areas were measured from maps of United States Geological Survey.

Discharge measurements of Sacramento River at Jellys Ferry, Tehama County.

Date.	Hydrographer.	Gage height.	Discharge.
1895.		*Feet.*	*Sec.-ft.*
Apr. 30	J. B. Lippincott	12	27,255
June 30	do	6.75	8,456
Aug. 25	A. P. Davis and J. B. Lippincott	5.55	5,452
Oct. 5	J. B. Lippincott	5.5	6,046
1896.			
Jan. 21	J. B. Lippincott	25.9	105,000
Jan. 22	do	22.7	82,000
July 7	C. C. Babb	6.6	6,924
Nov. 1	Richard Gernon	5.9	6,773
1897.			
Mar. 29	Fred Lemstrom	14.4	28,319
Mar. 13	do	10.3	18,568
Apr. 3	J. B. Lippincott	10.85	21,519
Apr. 16	Fred Lemstrom	12.2	25,806
Apr. 30	do	10.3	18,544
May 14	do	9	14,719
May 28	do	7.5	10,193
June 11	do	6.5	7,277
June 28	do	6.42	6,493
July 13	do	5.95	5,032
July 28	do	5.7	5,082
Aug. 13	do	5.6	4,285
Aug. 28	do	5.5	4,490
Sept. 13	do	5.5	4,257
Sept. 28	do	5.5	4,418
Oct. 13	do	5.6	4,591
Oct. 28	do	5.7	4,202
Nov. 13	do	5.7	4,196
Nov. 28	do	5.95	6,179
Dec. 13	do	7.4	10,151
Dec. 17	J. B. Lippincott	6.85	8,802
Dec. 28	Fred Lemstrom	5.95	6,105

Discharge measurements of Sacramento River at Jellys Ferry, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1898.		*Feet.*	*Sec.-ft.*
Jan. 28	Fred Lemstrom	5.7	5,578
Feb. 21	do	8.3	13,118
Feb. 28	do	15.32	42,020
Mar. 13	do	6.95	9,495
Mar. 28	do	6.1	7,155
Apr. 13	do	6.1	7,216
Apr. 27	do	6.2	7,606
May 13	do	5.5	5,473
May 28	do	7.92	12,477
June 3	J. B. Lippincott	7.1	9,048
June 13	Fred Lemstrom	5.9	6,162
June 28	do	5.45	5,093
July 13	do	5.2	4,625
July 28	do	5.1	4,520
Aug. 13	do	5	4,324
Aug. 27	do	5	4,089
Sept. 13	do	5	4,160
Sept. 28	do	5.1	4,322
Oct. 12	do	5.15	4,380
Oct. 28	do	5.15	4,271
Nov. 28	do	5.2	4,662
Dec. 13	do	5.2	4,367
Dec. 28	do	5.3	4,462
1899.			
Jan. 14	Fred Lemstrom	11.4	21,211
Jan. 28	do	7.5	10,299
Feb. 13	do	5.9	5,848
Feb. 28	do	6.1	6,380
Mar. 13	do	6.15	6,644
Mar. 29	do	11.5	21,985
Apr. 13	do	7.8	10,659
Apr. 28	do	7.3	7,813
May 13	do	6.65	7,630
June 3	do	6.9	8,409
June 13	do	5.9	6,104
June 28	do	5.5	4,866
July 13	do	5.25	4,276
July 28	do	5.05	4,025
Aug. 13	do	5.0	3,969
Aug. 28	do	5.0	3,764
Sept. 13	do	5.0	4,087
Sept. 28	do	5.0	4,009

Discharge measurements of Sacramento River at Jellys Ferry, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1900.		*Feet.*	*Sec.-ft.*
Feb. 17	Richard Gernon	6.8	8,374
Apr. 29	do	7.1	9,586
May 28	do	6.4	7,173
Sept. 20	S. G. Bennett	5.0	4,105
Dec. 18	do	10.0	18,361
1901.			
Jan. 27	S. G. Bennett	9.46	15,908
Apr. 9	do	7.8	11,112
Sept. 2	do	4.9	4,390

Estimated monthly discharge of Sacramento River at Jellys Ferry, Tehama County.

[Drainage area, 9,134 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	130,050	6,360	46,152	2,837,813	5.05	5.86
February	34,460	10,070	15,468	889,764	1.69	1.82
March	62,870	11,310	24,099	1,481,801	2.64	3.05
April	59,500	16,920	25,793	1,534,819	2.82	3.14
May	75,120	19,300	30,941	1,902,543	3.39	3.91
June	20,515	9,200	14,217	846,018	1.56	1.74
July	8,960	6,720	7,591	466,789	.83	.95
August	6,720	6,180	6,394	393,201	.70	.81
September	6,360	6,000	6,204	369,163	.68	.75
October	8,000	6,000	6,163	378,960	.67	.77
November	43,000	6,360	11,965	712,014	1.31	1.46
December	93,000	8,480	22,318	1,372,304	2.44	2.82
The year	130,050	6,000	18,109	13,185,189	1.98	27.08

Estimated monthly discharge of Sacramento River at Jellys Ferry, etc.—Cont'd.

Month.	Discharge.			Total discharge.	Run off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1897.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	49,765	8,320	14,280	878,050	1.56	1.80
February	89,100	17,420	36,108	2,005,335	3.95	4.11
March	44,340	13,100	21,790	1,339,825	2.39	2.76
April	28,710	18,830	22,807	1,357,108	2.50	2.79
May	18,520	9,200	13,737	844,660	1.50	1.73
June	9,200	6,680	7,620	453,420	.83	.92
July	6,550	5,120	5,699	350,420	.62	.71
August	5,120	4,600	4,776	293,667	.52	.60
September	4,600	4,600	4,600	273,718	.50	.56
October	6,680	4,600	4,955	304,673	.54	.62
November	8,600	5,120	5,590	332,627	.61	.68
December	16,940	5,380	7,792	479,114	.85	.98
The year	89,100	4,600	12,480	8,912,617	1.36	18.26
1898.						
January	6,525	5,835	6,120	376,307	.67	.77
February	33,600	5,835	12,479	693,049	1.37	1.43
March	22,500	6,525	9,745	599,201	1.07	1.23
April	7,260	6,525	6,872	408,911	.75	.83
May	10,800	5,375	6,632	407,789	.73	.84
June	10,500	5,150	6,674	397,130	.73	.81
July	5,150	4,475	4,700	288,994	.52	.60
August	4,475	4,250	4,276	262,923	.47	.54
September	4,475	4,250	4,280	254,677	.47	.53
October	4,925	4,475	4,631	284,751	.51	.59
November	6,892	4,475	4,785	284,727	.52	.58
December	5,950	4,700	4,991	306,887	.55	.63
The year	33,600	4,250	6,349	4,565,346	.70	9.38

Estimated monthly discharge of Sacramento River at Jellys Ferry, etc.—Cont'd.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	42,600	5,065	13,498	829,965	1.48	1.71
February	8,644	5,810	6,646	369,100	.73	.76
March	83,400	6,750	20,915	1,286,022	2.29	2.64
April	16,100	7,800	10,837	344,845	1.19	1.33
May	7,530	6,030	6,908	424,759	.76	.87
June	15,200	4,965	6,199	368,865	.68	.75
July	4,760	4,170	4,531	278,592	.50	.58
August	4,170	3,980	3,986	245,061	.44	.51
September	3,980	3,980	3,980	236,826	.44	.49
October	10,550	3,980	5,063	311,314	.55	.63
November	53,480	4,760	14,532	864,712	1.59	1.77
December	45,600	8,915	14,519	892,744	1.59	1.83
The year	83,400	3,980	9,301	6,752,805	1.02	13.87
1900.						
January	119,700	10,400	30,661	1,885,271	3.36	3.88
February	24,800	7,800	11,687	649,063	1.28	1.33
March	123,000	10,700	23,288	1,431,923	2.55	2.94
April	16,700	8,630	12,082	718,929	1.32	1.47
May	19,780	6,265	9,572	588,559	1.05	1.21
June	6,265	4,760	5,477	325,904	.60	.67
July	4,760	3,805	4,212	258,986	.46	.53
August	3,805	3,805	3,805	233,960	.42	.48
September	5,170	3,630	3,981	236,886	.44	.49
October	21,520	3,805	6,381	392,352	.70	.81
November	28,800	4,560	8,205	488,231	.90	1.00
December	80,100	6,030	15,553	956,317	1.70	1.96
The year	123,000	3,630	11,242	8,166,381	1.23	16.77

Estimated monthly discharge of Sacramento River at Jellys Ferry, etc.—Cont'd.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet*	*Sec.-feet.*	*Inches.*
January	74,240	8,915	20,983	1,290,194	2.30	2.66
February	101,880	9,800	34,138	1,895,928	3.74	3.89
March	46,100	12,200	20,628	1,268,366	2.26	2.61
April	16,700	9,200	10,870	646,810	1.19	1.33
May	13,700	7,530	9,804	602,824	1.07	1.23
June	7,265	4,965	5,596	332,985	.61	.68
July	4,760	3,980	4,365	268,393	.48	.55
August	3,980	3,805	3,850	236,727	.42	.48
September	5,380	3,630	3,922	233,375	.43	.48
October	5,380	3,980	4,194	257,879	.46	.53
November	44,100	4,360	7,745	460,859	.85	.94
December	61,800	5,380	12,149	747,013	1.33	1.53
The year	101,880	3,630	11,520	8,241,353	1.26	16.91
1902.						
January	6,750	4,760	5,376	330,557	.59	.68
February	151,320	5,660	69,153	3,840,563	7.44	7.75
March	61,700	14,150	27,371	1,682,977	2.94	3.39
April	53,800	14,150	21,992	1,308,615	2.37	2.64
May	24,460	10,150	17,803	1,094,663	1.92	2.21
June	13,450	7,060	9,998	594,922	1.08	1.20
July	7,060	5,880	6,192	380,731	.67	.77
August	5,880	5,440	5,674	348,881	.61	.70
September	5,220	5,000	5,007	297,938	.54	.60
October	11,750	5,000	5,931	364,683	.64	.74
November	118,200	5,660	19,834	1,180,204	2.13	2.38
December	39,100	8,110	17,506	1,076,402	1.88	2.17
The year	151,320	4,760	17,653	12,501,135	1.90	25.23

Discharge measurement of Upper Sacramento River, Shasta County, 1 mile above junction with Pitt River.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Sept. 10	S. G. Bennett	--------	242

Discharge measurements of Sacramento River.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
1902.		*Feet.*	*Sec.-feet.*	
Sept. 22	Charles A. Miller		384	Castle Crags, Shasta County.
Do	S. G. Bennett		286	Bards Station, Shasta County.
Do	Charles A. Miller		15	Soda Creek at Castle Crags, Shasta County.
Sept. 14	do		4,455	Balls Ferry, Tehama County.
Sept. 15	do		313	Battle Creek, near Balls Ferry, Tehama County.
Do	do		27	Ditch from Battle Creek, near Balls Ferry, Tehama County.
	Total		340	
Sept. 26	S. G. Bennett	7.22	5,848	Sacramento, Sacramento County.

SALINAS RIVER.

Salinas River rises in San Luis Obispo County, flows in a northwesterly direction through Salinas Valley, and discharges into the Bay of Monterey. The crest of the Coast Range, locally known as the Santa Lucia Mountains, forms the boundary of the watershed on the south and west; the crest of the Gabilan Mountains and the Mount Diablo Range forms the eastern boundary of the watershed. The total area drained is 4,780 square miles. The principal tributaries of the river, Nacimiento and San Antonio creeks and Arroyo Seco, drain the eastern slopes of the Santa Lucia Mountains. The only important stream entering from the east is San Lorenzo Creek, which drains the western slopes of the Mount Diablo Range.

A reconnaissance survey for reservoir sites on Salinas River and its tributaries was made during the period from May 28 to August 31, 1900, under the direction of Prof. Charles D. Marx, of Stanford University. These studies were continued by Mr. Homer Hamlin during the years 1901 and 1902, and the results are being prepared for publication.

A gaging station was established on the river January 8, 1900, by D. A. Porter. On account of the shifting nature of the channel during floods, four gage rods were set between January 8 and April 2, 1900, and each was referred to a different datum. On June 8, 1900, a permanent station was established at the county bridge, 3¾ miles south of Salinas. The gage, which is vertical, is attached to one of the piers of the bridge. The bench mark is a nail in the washer in the top of a redwood post, 13 inches by 15 inches in size, on the north bank of the river, at an elevation of 20 feet above gage datum.

On account of the continual shifting of the stream bed and the improbability of its water being used for either power or irrigation purposes, the record on this stream was discontinued August 3, 1901.

Discharge measurements of Salinas River, near Salinas, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1900.		*Feet.*	*Sec.-feet.*	
Apr. 9	S. G. Bennett	4.20	25.51	
Apr. 9	D. A. Porter	4.20	26.04	
Apr. 12	do	4.15	15.44	Strong wind upstream.
Apr. 15	do	4.10	13.10	Do.
Apr. 19	do	4.10	17.04	No wind.
Apr. 22	do	4.25	33.85	Do.
Apr. 25	do	4.15	18.91	Strong wind upstream.
May 1	do	4.10	18.02	No wind.
May 4	do	4.10	16.40	Do.
May 7	do	4.10	17.50	Do.
May 12	do	4.10	17.85	Do.
May 16	do	4.10	17.94	Light wind.
May 19	do	4.10	16.23	Do.
May 24	do	4.1	17.20	No wind.
May 29	do	4.1	17.43	Do.
June 2	do	4.05	13.32	Windy.
June 5	do	4.05	15.29	No wind.
June 8	do	4.0	14.05	Do.
June 12	do	4.05	15.79	Do.
June 15	do	4.05	15.32	Light wind.
June 18	do	4.0	13.93	Do.
June 22	do	4.0	12.91	No wind.
June 26	do	4.0	11.47	Light wind upstream.
June 30	do	3.9	10.50	No wind.
July 3	do	3.65	9.96	Fresh wind upstream.
July 16	do	3.70	9.56	No wind.
Aug. 1	do	3.70	9.83	Do.
Aug. 18	do	3.65	9.88	Light breeze downstream.
Sept. 1	do	3.65	10.10	No wind.
Sept. 26	S. G. Bennett	3.45	1.7	
Oct. 23	J. B. Lippincott	3.45	1.7	
Oct. 26	W. W. Cockins, jr.		1.1	1 mile below sugar factory.
Nov. 11	do	3.7	8.6	
Nov. 16	do	4.2	31.6	
Nov. 19	do	6.7	2,056	
Nov. 20	do	5.9	829	
Nov. 21	do	5.6	743	
Nov. 22	do	15.6	33,600	Float.
Nov. 23	do	9.7	12,851	Do.

Discharge measurements of Salinas River, near Salinas, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1901.		*Feet.*	*Sec.-feet.*	
Jan. 15	S. G. Bennett	6.8	2,142	
Jan. 22	do	5.8	1,338	
Jan. 24	W. W. Cockins, jr	5.9	1,598	
Feb. 9	S. G. Bennett	7.9	4,982	
Feb. 19	do	6.05	1,561	
Apr. 12	W. W. Cockins, jr	4.7	342	
Mar. 17	do	5.6	1,204	
Mar. 24	do	5.2	668	
Mar. 30	do	4.9	541	
Apr. 6	do	4.75	512	

Estimated monthly discharge of Salinas River at a point 4 miles south of Salinas, Monterey County.

[Drainage area, 4,084 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1900.						
January 8 to 31	2,700	223	848	40,368	0.21	0.19
February	223	40	105	5,831	.03	.03
March	223	25	73	4,489	.02	.02
April	32	19	22	1,309	.01	.01
May	19	17	17	1,045	.00	.00
June	17	15	16	952	.00	.00
July	10	6	8	492	.00	.00
August	8	6	7	430	.00	.00
September	8	2	6	357	.00	.00
October	4	1	2	123	.00	.00
November	33,600	0	2,413	143,583	.59	.66
December	1,050	82	295	18,139	.07	.08
The year	33,600	0	318	217,118	.08	.99

Estimated monthly discharge of Salinas River, etc.—Continued.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1901.						
January	35,162	380	4,921	302,580	1.21	1.39
February	20,927	540	4,172	231,701	1.02	1.06
March	1,772	430	1,063	65,361	.26	.30
April	405	160	270	16,066	.07	.07
May	2,012	160	533	32,773	.13	.15
June	160	30	56	3,332	.01	.02
July	30	25	27	1,660	.01	.01

Discharge measurements of Salinas River at bridge, Bradley, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Feb. 14	S. G. Bennett		1,424

TRIBUTARIES OF SALINAS RIVER.

ARROYO SECO.

This stream rises on the eastern slope of the Santa Lucia Mountains, flows eastward, and empties into Salinas River at Soledad, Cal. A gaging station was established December 30, 1900, by W. W. Cockins, jr., at Foster's ranch, near Piney, Cal. The high water of January, 1901, enlarged the old channel, and the gaging station was removed to Pettit's ranch, 4 miles below.

The purpose of establishing these gaging stations was to get the maximum flood discharge and the amount of water available for storage.

The total area of watershed drained above Pettit's ranch is 215 square miles.

Discharge measurements of Arroyo Seco, a tributary of Salinas River.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
1900.		*Feet.*	*Sec.-feet.*	
June 20, 2.30 p. m.	D. A. Porter		11.78	First pool above entrance of Santa Lucia, Monterey County.
June 20, 3.10 p. m.	do		12.42	Between second and third pools above entrance of Santa Lucia, Monterey County, Cal.
June 21, 8 a. m.	do		10.40	Road crossing of stream between Moor's and Abbott's houses, Monterey County, Cal.
June 21, 3.20 p. m.	do		7.30	200 feet above Currier's dam site, Monterey County, Cal.
June 21, 4.55 p. m.	do		6.14	50 feet below head gate Salina Valley Water Co.'s Arroyo Seco ditch No. 2. Canal was taking all water of creek on this date.
1901.				
Feb. 11	S. G. Bennett	3.70	535	Point near Foster's, Monterey County, Cal.
Mar. 26	W. W. Cockins, jr		162	Do.
Apr. 2	do	5.8	105	Pettitt's Ranch, Monterey County, Cal.
July 10	Homer Hamlin	5.3	23	Do.
Sept. 24	do		7.9	Do.
Nov. 6	H. E. Green	5.2	15	Do.
1902.				
Feb. 24	S. G. Bennett	8.2	[a]1,720	
Feb. 25	do	11.7	[a]7,883	
Feb. 26	do	9	[a]2,777	
Apr. 29	do	5.75	144	
July 18	Homer Hamlin	5.08	10.4	
Aug. 7	do	4.9	2.3	

[a] Float measurements.

Estimated monthly discharge of Arroyo Seco, a tributary of Salinas River, at Piney, Monterey County.

[Drainage area, 215 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	4,500	105	888	54,601	4.13	4.76
February	2,860	160	931	51,705	4.33	4.51
March	610	105	246	15,126	1.14	1.32
April	2,500	95	195	11,603	.91	1.01
May			95	5,841	.44	.51
June			58	3,451	.27	.30
July			22	1,353	.10	.12
August			15	922	.07	.08
September			8	476	.04	.04
October			10	615	.05	.05
November			22	1,309	.10	.11
December			26	1,599	.12	.14
The year			209	148,601	.98	12.95
1902.						
January	40	25	28	1,722	.13	.15
February	2,860	25	605	33,600	2.81	2.93
March	2,320	185	620	38,122	2.88	3.32
April	1,650	145	270	16,066	1.26	1.41
May	105	55	74	4,550	.34	.39
June	55	15	32	1,904	.15	.17
July	15	7	12	738	.06	.07
August	7	3	4	246	.02	.02
September	3	0	0	0	.00	.00
October	55	0	9	553	.04	.05
November	750	11	57	3,392	.27	.30
December	145	25	54	3,320	.25	.29
The year	2,860	0	147	104,213	.68	9.10

NACIMIENTO CREEK.

This stream drains the eastern slopes of the Santa Lucia Mountains and enters Salinas River 5 miles above Bradley, Cal. A gaging station was established on this stream at Harris ranch, near Bryson, Cal., by S. G. Bennett, on February 17, 1901. The record on this stream was discontinued April 30, 1901. The total area drained above the gaging station is 171 square miles.

Discharge measurements of Nacimiento Creek, a branch of Salinas River, at point near Bryson, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Feb. 17	S. G. Bennett	6.15	284
Mar. 25	W. W. Cockins, jr	5.3	105
Apr. 3	do	5.3	121

Discharge measurements of Nacimiento Creek, a branch of Salinas River, near Newhall Ranch house, San Migulito ranch, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Jan. 18	S. G. Bennett	6.1	106
Feb. 13	do	6.5	169
June 3	H. Hamlin	4.82	33
July 12	do	4.42	3.8

Estimated monthly discharge of Nacimiento Creek, a tributary of Salinas River, at Bryson, Monterey County.

[Drainage area, 171 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
	Sec.-feet.	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
February 17 to 28	3,300	295	855	20,350	5.00	5.21
March	365	110	184	11,314	1.08	1.24
April	670	87	99	5,891	.58	.65

Discharge measurements of Nacimiento Creek, a tributary of Salinas River, 4 miles above mouth, San Luis Obispo County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Feb. 15	S. G. Bennett		527

BURNETT CREEK.

Discharge measurements of Burnett Creek, tributary of Nacimiento Creek, a branch of Salinas River, San Luis Obispo County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Apr. 4	W. W. Cockins, jr		21

SAN ANTONIO CREEK.

This stream drains the eastern slopes of the Santa Lucia Mountains and enters the Salinas River at Bradley, Cal. A gaging station was established near Jolon, Cal., December 15, 1900, by W. W. Cockins, jr. The total area drained is 161 square miles. The record on this stream was discontinued April 30, 1901.

Discharge measurements of San Antonio Creek, Salinas River, near Jolon, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Jan. 19	S. G. Bennett	4.45	185
Feb. 12	do	4.8	242
Mar. 18	W. W. Cockins, jr	4.5	148
Mar. 26	do	4.3	76
Apr. 5	do	4.3	76
Apr. 18	do	4.1	59
July 11	H. Hamlin		.64

Discharge measurement of San Antonio Creek, Salinas River, Los Ojitos Dam site, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Apr. 17	J. B. Lippincott		50

Discharge measurement of San Antonio Creek, Salinas River, Pinkerton Dam site, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Apr. 17	J. B. Lippincott		37

Estimated monthly discharge of San Antonio Creek, a tributary of Salinas River, at Jolon, Monterey County.

[Drainage area, 161 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1900.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
December 15 to 28	200	170	184	5,109	1.14	0.59
1901.						
January	3,700	64	523	32,158	3.25	3.75
February	1,700	110	509	28,268	3.17	3.31
March	400	84	171	10,514	1.06	1.22
April	740	39	83	4,939	.52	.58

SAN LORENZO CREEK.

This stream drains the western slopes of the Gavilan Mountains and enters the Salinas River near Kings City, Cal. There is a reservoir and dam site on the stream 5 miles above its mouth. The stream is entirely dry during the summer months. The flood waters are used for winter irrigation. A gaging station was established December 16, 1900, by W. W. Cockins, jr., at Hollenbeck's ranch, a quarter of a mile below the dam site.

The area of the watershed drained is 235 square miles.

Discharge measurements of San Lorenzo Creek, Salinas River, at dam site, 5 miles above King City, Monterey County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
1901.		*Feet.*	*Sec.-feet.*	
Jan. 22	S. G. Bennett	4.98	28.7	Near Hollenbeck ranch house.
Feb. 14	do	5.3	71.2	Do.
Mar. 27	W. W. Cockins, jr	4.3	12.6	Do.
Apr. 1	do	4.2	5.1	Do.
Apr. 15	do	4.1	2.1	Do.
Nov. 2	H. E. Green	.9	2.8	Near Mathews ranch house.
1902.				
Jan. 24	S. G. Bennett	.9	4.6	Do.
Feb. 24	do	1.09	43.0	Do.
Apr. 30	do	.9	1.8	Do.
July 16	Homer Hamlin		.08	Do.

Estimated monthly discharge of San Lorenzo Creek, a tributary of Salinas River, at King City, Monterey County.

[Drainage area, 235 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1900.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
December 16 to 31	13	9	9	286	0.04	0.02
1901.						
January	2,540	9	171	10,514	.73	.84
February	9,200	9	725	40,264	3.09	3.21
March	27	9	17	1,045	.07	.08
April	13	6	8	476	.03	.03

Estimated monthly discharge of San Lorenzo Creek at King City.

[Drainage area, 235 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1902.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	15	5	6	369	.03	.03
February	795	5	69	3,832	.29	.30
March	875	5	81	4,980	.34	.39
April	5	3	4	238	.02	.02
November	200	15	85	5,057	.36	.40
December	15	5	7	430	.03	.03

SALT SPRING VALLEY.

Estimated seasonal discharge into Salt Spring Valley reservoir near Milton, Calaveras County, Cal.[a]

[Drainage area, 25 square miles.]

Year.	Mean discharge.	Total for year.	Run-off.		Rainfall.	Run-off.
			Per square mile.	Depth.		
	Sec.-feet.	*Acre-feet.*	*Sec.-feet.*	*Inches.*	*Inches.*	*Per cent.*
1889–90	36.7	26,606	1.47	19.95	30.38	65
1890–91	6.3	4,591	.25	3.39	13.06	26
1891–92	4.9	3,560	.20	2.71	16.98	16
1892–93	30.8	22,311	1.23	16.69	26.46	63
1893–94	22.5	16,323	.90	12.21	25.37	48
1894–95	35.4	25,664	1.42	19.27	32.31	59
1895–96	8.5	6,221	.34	4.61	23.98	19
Mean	20.7	15,099	.83	11.26	24.08	42

[a] Evaporation not considered in this table.

SAN ANTONIO CREEK.

The discharge of the streams of southern California was unusually low in September, 1898, and these measurements were made by the Edison Electric Company to determine the minimum with its hourly fluctuation.

Discharge measurements of San Antonio Creek, at Water Company's weir, San Bernardino County.

[Measurements by Edison Electric Co.]

Date.	Discharge.
	Sec.-feet.
September 15, 1898:	
7 a. m	5.60
7.30 a. m	5.60
8 a. m	5.60
8.30 a. m	5.60
9 a. m	5.58
9.30 a. m	5.58
10 a. m	5.58
10.30 a. m	5.44
11 a. m	5.32
11.30 a. m	5.32
12 m	5.32
12.30 p. m	5.32
1 p. m	5.06
1.30 p. m	5.06
2 p. m	5.06
2.30 p. m	5.06
3 p. m	4.94
3.30 p. m	4.94
4 p. m	4.94
4.30 p. m	4.80
5 p. m	4.80
5.30 p. m	4.80
6 p. m	4.92
6.30 p. m	5.06
12-hour mean	5.22
September 15, 1898:	
7 p. m	5.06
7.30 p. m	5.06
8 p. m	5.06
8.30 p. m	5.44
September 15, 1898—Cont'd.	
9 p. m	5.44
9.30 p. m	5.60
10 p. m	5.60
10.30 p. m	5.60
11 p. m	5.60
11.30 p. m	5.70
12 midnight	5.70
September 16, 1898:	
12.30 a. m	5.70
1 a. m	5.70
1.30 a. m	5.70
2 a. m	5.70
2.30 a. m	5.70
3 a. m	5.70
3.30 a. m	5.70
4 a. m	5.70
4.30 a. m	5.70
5 a. m	5.70
5.30 a. m	5.70
6 a. m	5.60
6.30 a. m	5.60
12-hour mean	5.57
September 16, 1898:	
7 a. m	5.60
7.30 a. m	5.60
8 a. m	5.60
8.30 a. m	5.60
9 a. m	5.60
9.30 a. m	5.60
10 a. m	5.44

Discharge measurements of San Antonio Creek, etc.—Continued.

Date.	Discharge.	Date.	Discharge.
September 16, 1898—Cont'd.	*Sec.-feet.*	September 16, 1898—Cont'd.	*Sec.-feet.*
10.30 a. m	5.20	9 p. m	5.44
11 a. m	5.18	9.30 p. m	5.44
11.30 a. m	5.06	10 p. m	5.44
12 m	5.06	10.30 p. m	5.60
12.30 p. m	4.94	11 p. m	5.60
1 p. m	4.94	11.30 p. m	5.60
1.30 p. m	5.06	12 midnight	5.60
2 p. m	5.06	September 17, 1898:	
2.30 p. m	5.06	12.30 a. m	5.60
3 p. m	5.06	1 a. m	5.60
3.30 p. m	4.80	1.30 a. m	5.60
4 p. m	4.80	2 a. m	5.60
4.30 p. m	4.56	2.30 a. m	5.60
5 p. m	5.06	3 a. m	5.60
5.30 p. m	5.06	3.30 a. m	5.70
6 p. m	5.06	4 a. m	5.70
6.30 p. m	4.92	4.30 a. m	5.70
12-hour mean	5.16	5 a. m	5.70
		5.30 a. m	5.70
September 16, 1898:		6 a. m	5.70
7 p. m	5.06	6.30 a. m	5.60
7.30 p. m	5.06	12-hour mean	5.52
8 p. m	5.06		
8.30 p. m	5.06		

Discharge measurements of San Antonio Creek, San Bernardino County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 23, 1896	J. H. Quinton	7.9	Mouth of canyon.
July 2, 1898	F. H. Olmsted	6.59	Do.
Aug. 26, 1898	do	5.18	Division weir.
Aug. 25, 1899	S. G. Bennett	4.48	Mouth of canyon.
July 11, 1900	do	4.07	Do.
Sept. 25, 1900	W. W. Cockins, jr	3.72	Division weir.
April 3, 1902	S. G. Bennett	11.40	Do.
July 23, 1896	J. H. Quinton	1.88	Ontario water from tunnel.
July 2, 1898	F. H. Olmsted	3.36	In creek at Pierce's camp.

The water of San Antonio Creek is utilized to a large extent. The Pacific Electric Light and Power Company, commonly called the San Gabriel Electric Company, has a power plant in the canyon at an elevation of 3,250 feet. The water from the tailrace of this power house passes over a measuring weir and is discharged into the pipe line of the San Antonio Water Company's power plant. It is carried in this conduit on the right bank of the canyon to a point opposite the old division weir between the San Antonio Water Company and the Pomona Land and Water Company, from which point it is discharged through the power house of the San Antonio Water Company. The portion of the water which goes to the San Antonio Water Company is again diverted through a pipe line and used at a third power house, at an elevation of about 1,900 feet, near the left bank of the canyon. In addition there is a tunnel in the mouth of the canyon run through the bowlders and gravels of the river bed to bed rock, up to and near the old division box mentioned above. This tunnel water together with all other water after it has been used for power is used for irrigation near Ontario and Pomona.

The second power plant on the river was constructed by the San Antonio Water Company during the year 1902, and before the water was diverted into the conduits of this corporation a board of engineers was appointed by the San Antonio Water Company to make measurements of the water in various portions of the canyon in order to determine what effect, if any, would result from the diversion of the stream which they contemplated from the upper power house of the San Gabriel Electric Company to the old division box. This board of engineers consisted of W. H. Saunders, chief engineer, F. E. Trask, Samuel Storrow, and J. B. Lippincott, consulting engineer. Suitable weirs were erected, and automatic river-height-recording devices were installed on most of these weirs. The San Gabriel Electric Company's power-house weir was located in the tailrace of the power house, and measured the main volume of water in the river at that point. The "Fountain of Life" spring is a small steady flow of water issuing from a spring near the San Gabriel Electric Company's power house, but the water is not included in that measured in the power-house weir. A small amount of water was flowing in the bed of the stream opposite the San Gabriel Electric Company's power house, and was not included in either the power-house weir or the "Fountain of Life" spring measurements.

The Spring Hill weir was located in the main river below the San Gabriel Electric Company's power house and measured total flow.

The "Baby Ruth" weir was also in the main stream below the San Gabriel Electric Company's power house, and above the division weir, and measured the full stream.

The division weir was located in the main stream opposite the power house of the San Antonio Water Company. At this point the

water is divided between the San Antonio Water Company and the Pomona Land and Water Company, but before the division occurs a certain amount of water, known as gird water, is taken out of the stream and not included in the measurement of the main division weir.

The water measured in the San Antonio tunnel is picked up from the sands and gravels of the river bed below all the above-mentioned points of measurements, and this water is not included in any other measurement.

All these measurements were made prior to the time when the diversion occurred through the new pipe line and power plant of the San Antonio Water Company.

All these measurements were made for the San Antonio Water Company by the engineers in question. They were supplemented by further continuous records obtained from the automatic registers; but these records are not now available for publication.

Discharge measurements of San Antonio Creek.

Date.	Hydrogapher.	Discharge.	Locality.
1902.		*Sec.-feet.*	
June 28	J. B. Lippincott	7.69	Baby Ruth weir.
July 12, 11.40 a. m	do	6.88	Do.
July 12, 1.13 p. m	do	6.58	Do.
Aug. 2, 11.15 a. m	do	6.15	Do.
Aug. 9, 11 a. m	do	6.15	Do.
Aug. 9, 1.12 p. m	do	5.99	Do.
Aug. 29, 11.45 a. m	do	5.61	Do.
Sept. 29, 12.30 p. m	do	4.88	Do.
Oct. 18, 12.30 p. m	do	4.74	Do.
June 28	do	6.56	Division weir.
Do	do	.42	Gird water.
		6.98	Total.
July 12, 10.58 a. m	do	5.76	Division weir.
Do	do	.35	Gird water.
		6.11	Total.
July 12, 2.40 p. m	do	5.20	Division weir.
Do	do	.35	Gird water.
		5.55	Total.

Discharge measurements of San Antonio Creek—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1902.		*Sec.-feet.*	
Aug. 2, 10.30 a. m	J. B. Lippincott	4.83	Division weir.
Do	do	.36	Gird water.
		5.19	Total.
Aug. 2, 2.30 p. m	do	4.35	Division weir.
Do	do	.36	Gird water.
		4.71	Total.
Aug. 9, 10.18 a. m	do	4.76	Division weir.
Do	do	.35	Gird water.
		5.11	Total.
Aug. 9, 2.40 p m	do	4.18	Division weir.
Do	do	.35	Gird water.
		4.53	Total.
Aug 29. 10.55 a. m	do	4.26	Division weir.
Do	do	.38	Gird water.
		4.64	Total.
Aug. 29, 2.27 p. m	do	3.55	Division weir.
Do	do	.38	Gird water.
		3.93	Total.
Sept. 27, 10.30 a. m	do	4.00	Division weir.
Do	do	.33	Gird water.
		4.33	Total.
Sept. 27, 2.15 p. m	do	3.57	Division weir.
Do	do	.33	Gird water.
		3.90	Total.
Oct. 18, 10.55 a. m	do	3.98	Division weir.
Do	do	.38	Gird water.
		4.36	Total.
June 28	do	.34	Fountain of Life spring—weir measurement.
July 12, 12.15 p. m	do	.34	Do.
Aug. 2, 12.05 p. m	do	.30	Do.

Discharge measurements of San Antonio Creek—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1902.		*Sec.-feet.*	
Aug. 9, 11.42 a. m	J. B. Lippincott	0.32	Fountain of Life spring—weir measurement.
Aug. 29, 12.20 p. m	do	.29	Do.
Sept. 27, 11.33 a. m	do	.29	Do.
Oct. 18, 12 m	do	.30	Do.
June 28	do	1.38	San Antonio tunnel—weir measurement.
July 12, 10.36 a. m	do	1.27	Do.
Aug. 2, 10.10 a. m	do	1.19	Do.
Aug. 9, 10 a. m	do	1.17	Do.
Aug. 30, 10.30 a. m	do	1.15	Do.
Sept. 27, 10.12 a. m	do	1.12	Do.
June 28	do	7.40	San Gabriel Electric Company's power house—concrete weir basin—weir measurement.
July 12, 12.20 p. m	do	6.10	Do.
Aug. 2, 12 m	do	5.59	Do.
Aug. 9, 11.48 a. m	do	5.67	Do.
Aug. 29, 12.30 p. m	do	4.59	Do.
Sept. 27, 11.37 a. m	do	4.64	Do.
Oct. 13, 11.38 a. m	do	4.31	Do.
June 28	do	.55	San Gabriel Electric Company's power house—weir measurement in creek.
July 12, 12.33 p. m	do	.47	Do.
Aug. 2, 12.10 p. m	do	.40	Do.
Aug. 9, 12.11 p. m	do	.40	Do.
Aug. 29, 12.40 p. m	do	.35	Do.
Sept. 27, 12 m	do	.36	Do.
Oct. 18, 12 m	do	.39	Do.
Aug. 2, 11.45 a. m	do	6.31	Spring Hill weir.
Aug. 9, 11.22 a. m	do	6.36	Do.
Aug. 9, 1 p. m	do	5.88	Do.
Aug. 29, 12.07 p. m	do	5.59	Do.
Aug. 29, 12.10 p. m	do	5.40	Do.
Sept. 27, 12.05 p. m	do	5.28	Do.
Oct. 18, 12.12 p. m	do	5.01	Do.

SAN BERNARDINO VALLEY.

Discharge measurements of San Bernardino Valley, between San Bernardino and Riverside.

Date.	Discharge.	Locality.
	Sec.-feet.	
June, 1898	0.61	Developed water, Camp Carlton ditch.
September, 1898	1.20	Do.
March, 1899	2.13	Do.
June, 1899	1.63	Do.
August, 1899	1.02	Do.
March, 1900	2.55	Do.
June, 1900	2.60	Do.
September, 1900	1.67	Do.
October 7, 1902	1.70	Do.
June, 1898	.67	Beams ditch, natural water.
September, 1898	.65	Do.
March, 1899	.72	Do.
June, 1899	.52	Do.
August, 1899	.40	Do.
March, 1900	.68	Do.
June, 1900	.50	Do.
September, 1900	.33	Do.
October 13, 1902	.22	Do.
June, 1898	5.26	Bloomington flume, developed water.
September, 1898	5.49	Do.
March, 1899	.00	Do.
June, 1899	5.93	Do.
August, 1899	3.05	Do.
March, 1900	3.80	Do.
June, 1900	3.68	Do.
September, 1900	3.28	Do.
October 7, 1902	2.28	Do.
June, 1898	6.82	City of Colton ditch, developed water.
September, 1898	7.40	Do.
March, 1899	3.20	Do.
June, 1899	5.49	Do.
August, 1899	3.89	Do.
March, 1900	4.94	Do.
June, 1900	3.21	Do.
September, 1900	3.54	Do.
October 7, 1902	3.53	Do.
June, 1898	1.97	Colton Terrace Water Co., developed water.
September, 1898	1.61	Do.

Discharge measurements of San Bernardino Valley, etc.—Continued.

Date.	Discharge.	Locality.
	Sec.-feet.	
March, 1899	1.69	Colton Terrace Water Co., developed water.
June, 1899	1.30	Do.
August, 1899	1.30	Do.
March, 1900	1.69	Do.
June, 1900	1.54	Do.
September, 1900	1.53	Do.
October 7, 1902	1.08	Do.
June, 1898	.63	Daley ditch, natural water.
September, 1898	.67	Do.
March, 1899	.71	Do.
June, 1899	.51	Do.
August, 1899	.51	Do.
March, 1900	.72	Do.
June, 1900	1.12	Do.
September, 1900	.54	Do.
October 13, 1902	.00	Do.
June, 1898	4.40	East Riverside district, or Riverside Highlands Water Co., developed water.
September, 1898	4.43	Do.
March, 1899	4.25	Do.
June, 1899	2.08	Do.
August, 1899	2.00	Do.
March, 1900	6.59	Do.
June, 1900	5.38	Do.
September, 1900	3.70	Do.
June, 1898	1.16	Gage canal, Santa Ana River, natural water.
September, 1898	1.16	Do.
March, 1899	.72	Do.
June, 1899	.24	Do.
August, 1899	.64	Do.
March, 1900	.395	Do.
June, 1900	.29	Do.
September, 1900	.17	Do.
October 7, 1902	.00	Do.
June, 1898	26.26	Gage canal, Palm avenue weir, developed water.
September, 1898	25.07	Do.
March, 1899	26.68	Do.
June, 1899	25.22	Do.
August, 1899	23.47	Do.
March, 1900	21.96	Do.
June, 1900	22.23	Do.

Discharge measurements of San Bernardino Valley, etc.—Continued.

Date.	Discharge	Locality.
	Sec.-feet.	
September, 1900	27.85	Gage canal, Palm avenue weir, developed water.
October 11, 1902	30.17	Do.
June, 1898	.84	Haws and Talmadge ditch, natural water.
September, 1898	.00	Do.
March, 1899	.28	Do.
June, 1899	.00	Do.
August, 1899	.00	Do.
March, 1900	.00	Do.
June, 1900	.00	Do.
September, 1900	.00	Do.
September 30, 1902	.00	Do.
June, 1898	.72	Logsdon and Farrell ditch, natural water.
September, 1898	.63	Do.
March, 1899	1.61	Do.
June, 1899	1.15	Do.
August, 1899	.54	Do.
March, 1900	1.26	Do.
June, 1900	.49	Do.
September, 1900	.20	Do.
October 13, 1902	.00	Do.
June, 1898	.37	McIntyre ditch, natural water.
September, 1898	.038	Do.
March, 1899	.82	Do.
June, 1899	.15	Do.
August, 1899	.00	Do.
March, 1900	.14	Do.
June, 1900	.01	Do.
September, 1900	.00	Do.
October 7, 1902	.00	Do.
June, 1898	2.54	McKenzie ditch, natural water.
September, 1898	2.08	Do.
March, 1899	9.40	Do.
June, 1899	3.86	Do.
August, 1899	2.00	Do.
March, 1900	2.30	Do.
June, 1900	1.57	Do.
September, 1900	1.69	Do.
September 30, 1902	.00	Do.
June, 1898	8.42	Meeks and Daley ditch, natural water.
September, 1898	17.00	Do.

Discharge measurements of San Bernardino Valley, etc.—Continued.

Date.	Discharge.	Locality.
	Sec. feet.	
March, 1899	17.00	Meeks and Daley ditch, natural water.
June, 1899	15.48	Do.
August, 1899	10.45	Do.
March, 1900	13.94	Do.
June, 1900	13.78	Do.
September, 1900	14.68	Do.
September 30, 1902	13.40	Do.
June, 1898	1.94	Mill pump, developed water.
September, 1898	2.04	Do.
March, 1899	.00	Not running.
June, 1899	1.77	Mill pump, developed water.
August, 1899	1.67	Do.
March, 1900	.00	Not running.
June, 1900	1.88	Mill pump, developed water.
September, 1900	1.52	Do.
September 30, 1902	1.20	Do.
June, 1898	5.37	Rabel dam ditch, natural water.
September, 1898	3.07	Do.
March, 1899	2.26	Do.
June, 1899	1.54	Do.
August, 1899	.94	Do.
March, 1900	.54	Do.
June, 1900	.35	Do.
September, 1900	.07	Do.
September 30, 1902	.00	Do.
June, 1898	1.75	Ranchero ditch, natural water.
September, 1898	1.64	Do.
March, 1899	1.64	Do.
June, 1899	1.00	Do.
August, 1899	.41	Do.
March, 1900	.24	Do.
June, 1900	.55	Do.
September, 1900	1.33	Do.
Do	.80	Ranchero ditch, developed water.
June, 1898	3.12	Riverside Water Company, natural water.
September, 1898	3.36	Do.
March, 1899	5.30	Do.
June, 1899	7.29	Do.
August, 1899	2.56	Do.
March, 1900	2.67	Do.

Discharge measurements of San Bernardino Valley, etc.—Continued.

Date.	Discharge.	Locality.
	Sec.-feet.	
June, 1900	2.17	Riverside Water Company, natural water.
September, 1900	.94	Do.
September 30, 1902	.50	Do.
June, 1898	2.30	Shay or Stout dam ditch, natural water.
September, 1898	2.08	Do.
March, 1899	2.23	Do.
June, 1899	1.13	Do.
August, 1899	.90	Do.
March, 1900	.507	Do.
June, 1900	.40	Do.
September, 1900	.16	Do.
September 30, 1902	.00	Do.
June, 1898	1.00	Swamp ditch, natural water.
September, 1898	1.02	Do.
March, 1899	.85	Do.
June, 1899	.77	Do.
August, 1899	.69	Do.
March, 1900	.70	Do.
June, 1900	.89	Do.
September, 1900	.86	Do.
October 14, 1902	.93	Do.
June, 1898	1.60	Ward and Warren ditch, developed water.
Do	.72	Ward and Warren ditch, natural water.
September, 1898	1.60	Ward and Warren ditch, developed water.
Do	.72	Ward and Warren ditch, natural water.
March, 1899	1.60	Ward and Warren ditch, developed water.
Do	1.49	Ward and Warren ditch, natural water.
June, 1899	.615	Ward and Warren ditch, developed water.
August, 1899	1.56	Do.
March, 1900	1.60	Do.
Do	.95	Ward and Warren ditch, natural water.
June, 1900	1.60	Ward and Warren ditch, developed water.
Do	.10	Ward and Warren ditch, natural water.
September, 1900	.53	Ward and Warren ditch, developed water.
October 14, 1902	.30	Do.
Do	1.58	Ward and Warren ditch, natural water.
June, 1898	.26	Whiting ditch, natural water.
September, 1898	.01	Do.
March, 1899	.76	Do.
June, 1899	.246	Do.

Discharge measurements of San Bernardino Valley, etc.—Continued.

Date.	Discharge.	Locality.
	Sec.-feet.	
August, 1899	0.01	Whiting ditch, natural water.
March, 1900	1.12	Do.
June, 1900	.13	Do.
September, 1900	.00	Do.
October 13, 1902	.00	Do.
June, 1898	.34	Whitlock ditch, natural water.
September, 1898	.38	Do.
March, 1899	.47	Do.
June, 1899	.28	Do.
August, 1899	.09	Do.
March, 1900	.23	Do.
June, 1900	.00	Do.
September, 1900	.00	Do.
October 13, 1902	.00	Do.

List of discharge measurements of San Bernardino Valley between San Bernardino and Colton.

Date.	Discharge.	Remarks.
	Sec.-feet.	
June, 1898	18.00	Riverside Water Co., upper canal, developed water.
Do	41.04	Riverside Water Co., upper canal, natural water.
September, 1898	17.54	Riverside Water Co., upper canal, developed water.
Do	43.80	Riverside Water Co., upper canal, natural water.
March, 1899	18.04	Riverside Water Co., upper canal, developed water.
Do	42.49	Riverside Water Co., upper canal, natural water.
June, 1899	17.50	Riverside Water Co., upper canal, developed water.
Do	36.42	Riverside Water Co., upper canal, natural water.
August, 1899	27.50	Riverside Water Co., upper canal, developed water.
Do	24.54	Riverside Water Co., upper canal, natural water.
March, 1900	24.54	Riverside Water Co., upper canal, developed water.
Do	37.40	Riverside Water Co., upper canal, natural water.
June, 1900	32.36	Riverside Water Co., upper canal, developed water.
Do	20.58	Riverside Water Co., upper canal, natural water.
September, 1900	27.00	Riverside Water Co., upper canal, developed water.
Do	34.02	Riverside Water Co., upper canal, natural water.
September 30, 1902	26.08	Riverside Water Co., upper canal, developed water.
Do	21.89	Riverside Water Co., upper canal, natural water.

Discharge measurements of return waters below Slover Mountain, above Riverside Narrows, San Bernardino Valley, between San Bernardino and Riverside.

Date.	Discharge.	Remarks.
1902.	*Sec.-feet.*	
September 29	5.94	West Riverside pumping plant, developed water.
October 11	4.38	Rogers pumping plant, developed water.
Do	2.95	Riverside Water Co., pumping plant No. 1, Santa Ana River flume, developed water.
Do	2.08	Riverside Water Co., pumping plant No. 2, Santa Ana River flume, developed water.
September 29	3.07	Riverside Water Co., flume head of lower canal, natural water.
Do	7.19	Roubidoux Canal, natural water.
Do	2.17	Evans ditch at north line Riverside County line, natural water.
Do	.53	Evans ditch 1 mile south Riverside County line, natural water.
Do	5.35	Evans Island ditch, west end of West Riverside bridge, natural water.
Do	1.96	Alvetriz ditch at east end West Riverside bridge, natural water.
October 10	43.25	Santa Ana River at Riverside Narrows.
Total	63.52	

Comparative amounts of water, in second-feet, flowing in canals above Colton.

Name of ditch.	June, 1898.	Sept., 1898.	Mar., 1899.	June, 1899.	Aug., 1899.	Mar., 1900.	June, 1900.	Sept., 1900.	Sept., 1902.
Haws & Talmage	0.84	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00
Rabel dam	5.37	3.07	2.36	1.54	.94	.54	.35	.07	.00
Shay or Stout dam	2.30	2.08	2.23	1.13	.90	.507	.40	.16	.00
McKenzie	2.54	2.08	9.40	3.86	2.00	2.30	1.57	1.69	.00
Meeks & Daley	8.42	[a]17.00	17.00	15.48	10.45	13.94	13.78	14.68	13.40
Beam	.67	[b].65	.72	.52	.40	.68	.50	.33	.22
Riverside Water Co., upper canal [b]	59.04	61.34	60.53	53.92	52.04	61.94	52.94	61.02	47.97
Timber	.00	.00	.00	.00	.00	.00	.00	.00	.00
Gage canal, Santa Ana River	1.16	1.16	.72	.24	.64	.395	.29	.17	.00
Gage canal, Palm avenue	[c]26.26	[c]25.07	[c]26.68	[c]25.22	[c]23.47	[c]21.96	[c]22.23	[c]27.85	[c]30.17
Logsdon & Farrell	.72	.63	1.61	1.15	.54	1.26	.49	.20	.00
Whitlock	.34	.38	.47	.28	.094	.23	.00	.00	.00
Daley	.63	.67	.71	.51	.51	.72	1.12	.54	.00
McIntyre	.37	.038	.82	.15	.00	.14	.01	.00	.00
Whiting	.26	.01	.76	.246	.01	1.12	.13	.00	.00
Swamp	1.00	1.02	.85	.77	.69	.70	.89	.86	.93
Ranchero	[a]1.75	1.64	1.64	1.00	.41	.24	.55	1.33	2.28
Ward & Warren	2.32	[a]2.32	3.09	.615	1.56	2.55	1.70	.53	1.88
Mill flume of Riverside Water Co	3.12	3.36	5.30	7.29	2.56	2.67	2.17	.94	.50
Mill pump of Riverside Water Co	1.94	2.04	([d])	1.77	1.67	([d])	1.88	1.52	1.20
Camp Carlton	.61	1.20	2.13	1.62	1.02	2.55	2.60	1.67	1.70
East Riverside	4.40	4.43	4.25	2.08	2.00	6.59	5.38	3.70	.....
Colton Terrace Water Co	1.97	1.61	1.69	1.30	1.30	1.69	1.54	1.53	1.08
City of Colton	6.82	7.40	3.20	5.49	3.89	4.94	3.21	3.54	3.53
Bloomington flume	5.26	5.49	([d])	5.93	3.05	3.80	3.68	3.28	.00
West Riverside 350-inch pumping plant	.....	.....	.....	.....	.....	.....	.....	.....	5.94
Rogers pumping plant	.....	.....	.....	.....	.....	.....	.....	.....	4.38
Santa Ana River flume; Riverside pumping plants Nos. 1 and 2	.....	.....	.....	.....	.....	.....	.....	.....	5.03
Total	138.11	144.69	146.44	132.11	110.14	131.46	117.41	125.61	120.21

[a] Interpolated. [b] Above Slover Mountain. [c] River water not included. [d] Pumps not run.

Return water, natural flow in second-feet, compared with developed water in San Bernardino Valley above Colton.

Name of ditch.	June, 1898.		September, 1898.		March, 1899.		June, 1899.	
	Developed.	Natural.	Developed.	Natural.	Developed.	Natural.	Developed.	Natural.
Haws & Talmage		0.84		0.00		0.28		0.00
Rabel dam		5.37		3.07		2.36		1.54
Shay or Stout dam		2.30		2.08		2.23		1.13
McKenzie		2.54		2.08		9.40		3.86
Beam		.67		.65		.72		.52
Riverside Water Co., upper canal	18.00	41.04	17.54	43.80	18.04	42.49	17.50	36.42
Gage canal, Santa Ana River		1.16		1.16		.72		.24
Gage canal, Palm avenue weir	26.26		25.07		26.68		25.22	
Logsdon & Farrell		.72		.63		1.61		1.15
Whitlock		.34		.38		.47		.28
Daley		.63		.67		.71		.51
McIntyre		.37		.038		.82		.15
Whiting		.26		.010		.76		.246
Swamp		1.00		1.020		.85		.77
Ranchero		[a] 1.75		1.640		1.64		1.00
Ward & Warren	1.60	.72	1.60	.720	1.60	1.49	.615	
Mill flume of Riverside Water Co		3.12		3.360		5.30		7.29
Mill pump of Riverside Water Co	1.94		2.04		Not run.		1.77	
Camp Carlton ditch	.61		1.20		2.13		1.62	
East Riverside district, or Riverside Highland Water Co	4.40		4.43		4.25		2.08	
Colton Terrace Water Co	1.97		1.61		1.69		1.30	
City of Colton pumping plant	6.82		7.40		3.20		5.49	
Bloomington flume	5.26		5.49		.00		5.93	
Meeks & Daley ditch		8.42		[a] 17.00		17.00		15.48
Total	66.86	71.25	66.38	78.31	57.59	88.85	61.525	70.59

[a] Interpolated.

Return water, natural flow in second-feet, etc.—Continued.

Name of ditch.	August, 1899.		March, 1900.		June, 1900.		September, 1900.		September, 1902.	
	Developed.	Natural.	Developed.	Natural.	Developed.	Natural.	Developed.	Natural.	Developed.	Natural.
Haws & Talmage		0.00		0.000	0.00	0.00		0.00		0.00
Rabel dam		.94		.540		.35		.07		.00
Shay or Stout dam		.90		.507		.40		.16		.00
McKenzie		2.00		2.300		1.57		1.69		.00
Beam		.40		.680		.50		.33		.22
Riverside Water Co., upper canal	27.50	24.54	24.54	37.40	32.36	20.58	27.00	34.02	26.08	21.89
Gage canal, Santa Ana River		.64		.395		.29		.17		.00
Gage canal, Palm avenue weir	23.47		21.96		22.23		27.85		30.17	
Logsdon & Farrell		.54		1.26		.49		.20		.00
Whitlock		.09		.23		.00		.00		.00
Daley		.51		.72		1.12		.54		.00
McIntyre		.00		.14		.01		.00		.00
Whiting		.01		1.12		.13		.00		.00
Swamp		.69		.70		.89		.86		.93
Ranchero		.41		.24		.55	.80	.53	2.28	
Ward & Warren	1.56		1.60	.95	1.60	.10	.53		.30	1.58
Mill flume of Riverside Water Co		2.56		2.67		2.17		.94		.50
Mill pump of Riverside Water Co	1.67			Not run.	1.88		1.52		1.20	
Camp Carlton ditch	1.02		2.55		2.60		1.67		1.70	
East Riverside district, or Riverside Highland Water Co	2.00		6.59		5.38		3.70			
Colton Terrace Water Co	1.30		1.69		1.54		1.53		1.08	
City of Colton pumping plant	3.89		4.94		3.21		3.54		3.53	
Bloomington flume	3.05		3.80		3.68		3.28		.00	
Meeks & Daley ditch		10.45		13.94		13.78		14.68		13.40
West Riverside 350-inch pumping plant									5.94	
Rogers pumping plant									4.38	
Santa Ana River flume; Riverside pumping plant Nos. 1 and 2									5.03	
Total	65.46	44.68	67.67	63.79	74.48	42.93	71.42	54.18	81.69	38.52

From the two preceding tables it will be noted that despite severe droughts which existed from 1898 to 1902, inclusive, the output of water from the gravel beds above Colton has but slightly diminished, the total being 144.69 second-feet in September, 1898, as compared with 120.21 second-feet in September, 1902. The amount of developed water in September, 1898, was 66.38 second-feet, and in September, 1902, 81.69 second-feet, while the natural return water between the same dates decreased from 78.31 second-feet to 38.52 second-feet. During this period much development work was done, and while these new supplies do not mean an absolute addition to the output from the district, the fact that the total supply was maintained notwithstanding the drought is a decided achievement.

SAN DIEMAS WASH.

See San Gabriel River, miscellaneous measurements, San Diemas Wash.

SAN FERNANDO CREEK.

Discharge measurement of San Fernando Creek, tributary of Los Angeles River, at San Fernando Mission, Los Angeles County.

Date.	Hydrographer.	Discharge.
1901.		*Sec.-feet.*
Jan. 28	J. B. Lippincott	3.21

SAN FRANCISQUITO CREEK.

Discharge measurement of San Francisquito Creek at junction with Santa Clara River, Los Angeles County.

Date.	Hydrographer.	Discharge.
1898.		*Sec.-feet.*
Aug. 11	F. H. Olmsted	2.07

SAN GABRIEL RIVER.

The drainage basin of this river lies on the southern slope of the Sierra Madre, the watershed being included in Los Angeles County, Cal. The various tributaries join the river before it enters its lowest canyon, whence it appears finally on the plain in the vicinity of Azusa. The seepage waters appear lower down in the valley. The floods discharge into the Pacific Ocean through a number of poorly defined storm channels. All the summer flow of this stream is now used for irrigation purposes in the vicinity of Azusa. Owing to the numerous diversions, it has been difficult to obtain accurate discharge measurements, but during 1898 the San Gabriel Electric Company completed its system, and measurements are now obtained with greater ease, and hence with greater accuracy. The head works of this company are located about 6 miles above the mouth of the canyon, the water is carried along the left side by a series of tunnels and

conduits, and a head of 400 feet is obtained where the electric power is generated. Weirs are placed on the conduit of the electric company, and the low water is measured at this point. The capacity of the conduit is 90 second-feet. The gaging station on the main river is located at the mouth of the canyon. The equipment consists of a rod, a cable, a car, and a tagged wire.

Discharge measurements of San Gabriel River at point near mouth of canyon near Azusa, Los Angeles County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1895.		*Feet.*	*Sec.-feet.*	
Sept. 10	J. B. Lippincott	1.19	34.93	Total flow, meter measurement.
Nov. 5	do		13.25	Total flow.
Dec. 11	do		0.00	River.
Do	do		37.50	Canals.
Dec. 21	do	1.9	27.30	River.
Do	do		26.60	Canals.
	Total		53.90	
Dec. 21	J. B. Lippincott		27.05	River.
Do	do		26.60	Canals.
	Total		53.65	
1896.				
Feb. 17	J. B. Lippincott	1.35	4.86	River.
Do	do		33.00	Canals.
	Total		37.86	
Mar. 22	J. B. Lippincott	2.27	69.91	River.
Do	do		35.20	Canals.
	Total		105.11	
Apr. 30	J. B. Lippincott		0.00	River.
Do	do		55.20	Canals.
June 17	do		25.14	Irrigators upper weir.
Do	do		19.94	River.
Do	do		3.99	Azusa irrigation development.
Do	do		1.54	Vineland tunnel.
	Total		25.47	
July 22	John H. Quinton		0.00	River.
Do	do		26.75	Canals.
Nov. 22	J. B. Lippincott		0.00	
Do	do		21.10	Canals.

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1897.		*Feet.*	*Sec.-feet.*	
Jan. 10	J. B. Lippincott	1.28	4.50	River.
Do	do		19.93	Canals.
Do	do		1.65	Vineland canal water.
	Total		26.08	
Jan. 25	J. B. Lippincott	2.00	57.79	River.
Do	do		16.20	Canals.
Do	do		1.13	Vineland canal water.
	Total		75.12	
Feb. 1	J. B. Lippincott	5.1	1,725.0	River.
Do	do		00.0	Canals.
Feb. 2	do	3.4	422.1	River.
Do	do		00.0	Canals.
Mar. 12	do	3.3	410.1	River.
Do	do		18.0	Canals.
	Total		428.1	
Apr. 29	J. B. Lippincott	2.6	162.30	River.
Do	do		71.27	Canals.
	Total		233.57	
May 24	J. B. Lippincott	2.08	76.00	River.
Do	do		67.90	Canals.
	Total		143.90	
June 30	A. Q. Campbell		0.00	River.
Do	do		55.68	Canals.
July 5	do		0.00	River.
Do	do		53.94	Canals.
Aug. 7	do		0.00	River.
Do	do	2.33	31.37	Canals.
Sept. 1	do		0.00	River.
Do	do	2.2	24.25	Canals.
Sept. 29	do		0.00	River.
Do	do	2.1	19.28	Canals.
Nov. 13	do		7.56	River.
Do	do		24.16	Canals.
	Total		31.72	

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1897.		*Feet.*	*Sec.-feet.*	
Nov. 27	J. B. Lippincott		3.50	River.
Do	do		32.89	Canals.
	Total		36.39	
Nov. 28	J. B. Lippincott		42.11	At San Gabriel Power Company's intake: total flow.
1898.				
Jan. 12	do	1.36	23.29	River.
Do	do		25.00	Canals.
	Total		48.29	
Mar. 8	H. F. Crowe		12.3	Duarte canal.
Do	do		36.9	Azusa canal.
	Total river		49.2	
Apr. 2	J. B. Lippincott		11.30	Duarte canal.
Do	do		29.92	Azusa canal.
	Total river		41.22	
May 10	J. B. Lippincott		0	River.
Do	do		23.34	Canals.
May 17	do	1.03	15.40	River.
Do	do		44.61	Canals.
	Total		60.01	
July 1	F. H. Olmsted		3.59	Duarte canal.
Do	do		11.78	Azusa canal at Slaughterhouse tunnel.
	Total river		15.37	
July 21	J. B. Lippincott		0	River.
Do	do		13.21	San Gabriel Power Company's canal headworks.
Aug. 16	do		0	Power Co.'s headworks; 3 p. m.
Do	do		6.20	Canals; 3 p. m.
Do	do		5.78	Canals; 4 p. m.
Do	do		5.60	Canals; 5 p. m.
Do	do		5.60	Canals; 6 p. m.
Do	do		5.78	Canals; 7 p. m.
Aug. 21	do		5.78	Canals; 8 p. m.

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1898.		*Feet.*	*Sec.-feet.*	
Aug. 22	J. B. Lippincott		0.00	River; 8 p. m.
Do	do		6.20	Canals; 8 p. m.
Aug. 23	do		0	River; 10 a. m
Do	do		8.48	Daily maximum; 10 a. m.
1899.				
Jan. 11	do	1.16	15.9	River.
Do	do		5.0	Waste.
Do	do		28.3	Canals.
	Total		49.2	
Jan. 16 to 19.	H. F. Parkinson		18.00	River and canals.
Aug. 26	do		5.5	Canals; no water in river.
1900.				
Nov. 21	S. G. Bennett		0	River; 11 a. m.
Do	do		20.15	Waste.
Do	do		26.13	Canal.
	Total		46.28	
1901.				
Jan. 7	S. G. Bennett	6.16	2,709.0	River (calculated).
Do	do		0	Canals.
Feb. 4	do	2.30	112.0	River.
Do	do		65.0	Canals.
	Total		177.0	
Feb. 5	S. G. Bennett	7.6	6,253.0	River (calculated).
Do	do		0	Canals.
Feb. 22	do	4.1	700.4	River.
Do	do		65.0	Canals.
	Total		765.4	
Mar. 5	S. G. Bennett	3.00	248.0	River.
Do	do		65.0	Canals.
	Total		313.0	

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1901.		*Feet.*	*Sec.-feet*	
Mar. 29	S. G. Bennett	2.25	96.5	River.
Do	do		33.0	Canal.
	Total		129.5	
July 11	S. G. Bennett		0	River.
Do	do		31.6	Canal.
1902.				
Jan. 25	W. B. Clapp		0	River.
Do	do		50.94	Canals.
Feb. 26	J. B. Lippincott	2.05	126.19	River.
Do	do		64.00	Canal.
	Total		190.19	
Mar. 6	J. Ahern	1.57	46.2	River.
Do	do		62.0	Canals.
	Total		108.2	
Apr. 8	S. G. Bennett	1.4	26.0	River.
Do	do		44.6	Canals.
	Total		70.6	
June 12	S. G. Bennett		0	River.
Do	do		25.7	Canals.
Sept. 1	W. B. Clapp		5.0	Total flow.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
June 17, 1896	J. B. Lippincott	3.99	Azusa Irrigators Development Tunnel.
Aug. 24, 1898	do	.22	Same place; river being diverted through power company's conduit.
Do	do	.30	Irrigators Development Tunnel, pumped; additional.

Discharge measurements of San Gabriel River, Azusa, Los Angeles County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
June 17, 1896	J. B. Lippincott	1.54	Mouth of Vineland tunnel.
Do	do	2.11	Same; pump running.
Apr. 29, 1897	do	2.23	Mouth of Vineland tunnel.
Do	do	2.11	Same; shaft No. 2.
Do	do	2.13	Same; at head of flume, between shafts Nos. 3 and 4.
Do	do	1.07	Same; right fork, above shaft No. 4.
May 24, 1897	do	1.88	Mouth of Vineland Tunnel.

Discharge measurements of San Gabriel River at intake of San Gabriel Power Company, Los Angeles County.

[Measurements by Edison Electric Company. The flow was unusually small in September, 1898, and these measurements were made to determine this minimum and its hourly fluctuation.]

Date.	Discharge.	Date.	Discharge.
September 15, 1898:	*Sec.-feet.*	September 15, 1898—Cont'd.	*Sec.-feet.*
7 a. m	8.16	6 p. m	6.94
7.30 a. m	8.28	6.30 p. m	6.94
8 a. m	8.40	12-hour mean	7.99
8.30 a. m	8.50		
9 a. m	8.72	September 15, 1898:	
9.30 a. m	8.84	7 p. m	6.94
10 a. m	8.84	7.30 p. m	6.94
10.30 a. m	8.84	8 p. m	6.94
11 a. m	8.84	8.30 p. m	6.94
11.30 a. m	8.72	9 p. m	7.04
12 m	8.62	9.30 p. m	7.04
12.30 p. m	8.40	10 p. m	7.04
1 p. m	8.28	10.30 p. m	7.04
1.30 p. m	8.06	11 p. m	7.04
2 p. m	7.84	11.30 p. m	7.04
2.30 p. m	7.62	12 midnight	7.04
3 p. m	7.50	September 16, 1898:	
3.30 p. m	7.40	12.30 a. m	7.04
4 p. m	7.18	1 a. m	7.04
4.30 p. m	7.04	1.30 a. m	7.18
5 p. m	6.94	2 a. m	7.18
5.30 p. m	6.94	2.30 a. m	7.28

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Discharge.
September 16, 1898—Cont'd.	*Sec.-feet*
3 a. m	7.40
3.30 a. m	7.50
4 a. m	7.62
4.30 a. m	7.72
5 a. m	7.84
5.30 a. m	7.96
6 a. m	8.06
6.30 a. m	8.06
12-hour mean	7.29
September 16, 1898:	
7 a. m	8.28
7.30 a. m	8.40
8 a. m	8.28
8.30 a. m	8.50
9 a. m	8.72
9.30 a. m	8.94
10 a. m	9.06
10.30 a. m	9.06
11 a. m	8.94
11.30 a. m	8.84
12 m	8.72
12.30 p. m	8.50
1 p. m	8.28
1.30 p. m	8.06
2 p. m	7.84
2.30 p. m	7.62
3 p. m	7.50
3.30 p. m	7.40
4 p. m	7.18
4.30 p. m	7.04
5 p. m	6.94

Date	Discharge.
September 16, 1898—Cont'd.	*Sec.-feet.*
5.30 p. m	6.82
6 p. m	6.82
6.30 p. m	6.82
12-hour mean	8.02
September 16, 1898:	
7 p. m	6.72
7.30 p. m	6.60
8 p. m	6.60
8.30 p. m	6.60
9 p. m	6.60
9.30 p. m	6.60
10 p. m	6.50
10.30 p. m	6.50
11 p. m	6.60
11.30 p. m	6.60
12 midnight	6.72
September 17, 1898:	
12.30 a. m	6.82
1 a. m	6.82
1.30 a. m	6.82
2 a. m	6.94
2.30 a. m	7.04
3 a. m	7.04
3.30 a. m	7.04
4 a. m	7.00
4.30 a. m	6.92
5 a. m	7.40
5.30 a. m	7.50
6 a. m	7.62
6.30 a. m	7.72
12-hour mean	6.89

The following table is prepared from measurements made three times daily for the San Gabriel Electric Company, and filed in a suit before the United States land office at Los Angeles, Cal. The mean of the three daily measurements is here given.

Estimated daily discharge, in second-feet, of San Gabriel River over weir on West Branch of North Fork, at Sycamore Flat, for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1		0.23	0.19	0.20
2	0.28	.23	.19	.12
3	.27	.23	.17	.18
4	.27	.26	.22	.18
5	.26	.17	.12	.23
6	.28	.23	.12	.23
7	.24	.23	.22	.19
8	.23	.22	.18	.19
9	.25	.12	.20	.19
10	.23	.12	.22	.19
11	.25	.19	.22	.19
12	.25	.19	.22	.19
13	.22	.19	.22	.22
14	.27	.19	.18	
15	.27	.15	.18	
16	.31	.26	.12	
17	.31	.23	.12	
18	.27	.23	.25	
19	.31	.23	.15	
20	.39	.22	.12	
21	.39	.22	.15	
22	.24	.22	.12	
23	.26	.22	.15	
24	.26	.22	.22	
25	.28	.22	.27	
26	.37	.23	.26	
27	.37	.18	.26	
28	.26	.18	.22	
29	.23	.25	.20	
30	.23	.20	.17	
31	.23			
Total	.28	.21	.19	.19

Estimated daily discharge, in second-feet, of San Gabriel River over weir on North Branch of North Fork, at Sycamore Flat, for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1		0.89	0.62	0.65
2	0.92	.89	.62	.72
3	.92	.89	.62	.68
4	.92	.95	.62	.68
5	.89	.95	.60	.68
6	.89	.74	.65	.68
7	.89	.74	.61	.56
8	.82	.74	.61	.56
9	.80	.77	.83	.56
10	.70	.77	.61	.57
11	.81	.74	.61	.59
12	.83	.74	.63	.59
13	.86	.77	.61	.59
14	.95	.68	.63	
15	.97	.74	.63	
16	.97	.62	.59	
17	.97	.65	.59	
18	.97	.65	.59	
19	.97	.62	.59	
20	.97	.60	.59	
21	.97	.60	.53	
22	.96		.53	
23	1.07	.55	.53	
24	.95	.52	.81	
25	.95	.52	.68	
26	.96	.56	.65	
27	.68	.57	.65	
28	.68	.57	.68	
29	.89	.57	.68	
30	.86	.74	.68	
31	.68			
Total	.89	.70	.63	.62

Estimated daily discharge, in second-feet, of San Gabriel River over weir on West Fork above mouth of North Fork for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1	0.55	0.05	0.12	0.16
2	.62	.02	.12	.16
3	.68		.12	.16
4	.62		.12	.16
5	.53		.08	.15
6	.55		.11	.20
7	.55		.16	.20
8	.55		.12	.16
9	.44		.12	.16
10	.34		.16	.13
11	.29		.16	.20
12	.26	.08	.12	.20
13	.24	.07	.12	.20
14	.20	.08	.16	
15	.13	.08	.16	
16	.12	.12	.16	
17	.16	.10	.16	
18	.16	.12	.11	
19	.12	.10	.12	
20	.12	.12	.12	
21	.07	.12	.16	
22	.12	.10	.16	
23		.07		
24		.08		
25	.08	.08	.12	
26			.20	
27		.08	.16	
28	.05	.08	.16	
29	.08	.10	.13	
30	.05	.12	.14	
31	.05	.10		
Total	.29	.09	.14	.17

Estimated daily discharge, in second-feet, of San Gabriel River over weir on Coldwater Creek, 2½ miles above mouth, for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1		0.43	0.52	
2			.58	0.60
3		.49	.62	.62
4		.46	.57	.61
5		.54	.55	.63
6		.53	.56	.61
7		.50	.51	.58
8		.50	.51	.58
9		.53	.56	.58
10		.53	.50	.55
11		.53	.55	.60
12		.51	.52	.60
13		.46		.64
14		.47		
15		.45		
16		.45		
17		.47		
18		.47		
19		.52		
20		.55		
21		.56		
22		.51		
23		.49		
24		.45		
25		.44		
26		.45		
27	0.37	.42		
28	.49	.42		
29	.50	.41		
30	.47	.40		
31	.46	.56		
Total	.46	.48	.55	.60

Estimated daily discharge, in second-feet, of San Gabriel River over weir 100 yards above Fish Fork, for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1	2.24			1.67
2	2.48			1.67
3	2.48	1.72		1.71
4	2.42	1.80		1.84
5	2.33	1.80		1.84
6	2.27	1.80		1.80
7	2.06	1.80		1.72
8	2.12	1.80		1.67
9	2.09	1.80	1.84	1.71
10	2.15	1.80	1.80	1.71
11	2.09	1.80	1.72	1.75
12	2.15	1.97	1.76	1.76
13	2.15	1.92	1.72	1.89
14	2.03	1.85	1.76	
15	2.03	1.80	1.76	
16	2.12	1.68	1.80	
17	2.00	1.76	1.71	
18	2.00	1.68	1.72	
19	1.97	1.68	1.72	
20	1.97	1.64	1.68	
21	2.00	1.68	1.59	
22	2.00	1.68	1.63	
23	2.00	1.68	1.79	
24	1.97	1.68	1.89	
25	2.18	1.76	1.84	
26	2.00	1.68	1.84	
27	2.00	1.60	1.67	
28	1.95	1.60	1.63	
29	1.77	1.68	1.67	
30	1.77	1.68	1.79	
31		1.97		
Total	2.09	1.75	1.74	1.75

Estimated daily discharge, in second-feet, of San Gabriel River over weir on Fish Fork, 100 yards from mouth, for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1	1.42	.....	.....	0.95
2	1.66	.....	.....	.90
3	1.68	0.99	.....	.95
4	1.66	.96	.....	.96
5	1.28	1.02	.....	.93
6	1.25	1.06	.....	.93
7	1.16	1.06	.....	.93
8	1.18	.92	.....	.93
9	1.08	.95	1.52	.90
10	.98	1.02	.92	.89
11	.96	.99	.96	.95
12	.98	1.11	1.13	.95
13	.98	1.11	1.10	1.01
14	1.04	1.02	.99	.....
15	1.02	.99	1.08	.....
16	1.25	.90	.94	.....
17	.93	.90	.93	.....
18	1.00	.84	.89	.....
19	1.00	.84	.86	.....
20	1.00	.95	.84	.....
21	1.12	.89	.84	.....
22	1.12	.90	.80	.....
23	1.13	.90	.98	.....
24	1.06	.90	1.02	.....
25	1.02	.92	1.01	.....
26	.90	.92	.98	.....
27	.90	.92	.78	.....
28	.90	.92	.80	.....
29	.87	.99	.81	.....
30	.87	.95	.84	.....
31	.....	1.08	.....	.....
Total	1.11	.96	.96	.94

Estimated daily discharge, in second-feet, of San Gabriel River over weir on Iron Fork, 100 yards from mouth, for 1900.

[Observer, San Gabriel Power Company.]

Day.	July.	August.	September.	October.
1	1.97			1.05
2	1.97	0.87		1.08
3	2.03	1.05		1.05
4	2.09	1.09		1.12
5	1.89	1.16		1.20
6	1.91	1.16		1.12
7	1.83	.62		1.09
8	1.66	1.16		1.16
9	1.55	1.12	1.09	1.12
10	1.58	1.16	1.12	1.09
11	1.50	1.24	1.12	1.20
12	1.39	1.06	1.09	1.20
13	1.42	1.09	1.09	1.23
14	1.42	1.20	1.12	1.31
15	1.44	1.24	1.16	
16	1.42	1.12	1.09	
17	1.42	1.12	1.16	
18	1.37	1.09	1.09	
19	1.37	1.09	1.09	
20	1.42	1.16	1.05	
21	1.31	1.12	.91	
22	1.34	1.12	.87	
23	1.37	1.02	1.12	
24	1.24	1.02	1.27	
25	1.29	.95	1.20	
26	1.24	.95	1.20	
27	1.26	.95	1.05	
28	1.21	1.02	1.01	
29	1.09	1.09	1.01	
30	1.14	1.09	1.16	
31	1.24	1.12		
Total	1.50	1.07	1.09	1.14

Discharge measurements of San Gabriel River at point above Iron Fork.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
November, 1896	F. C. Finkle	7.7
December, 1896	do	7.4
January, 1897	do	28.4
February, 1897	do	42.0
March, 1897	do	52.1
April, 1897	do	27.9
May, 1897	do	24.7
June, 1897	do	25.4
July, 1897	do	17.8
August, 1897	do	16.4
September, 1897	do	16.5
April, 1900	J. B. Lippincott et al	5.76

Discharge measurements of Iron Fork of San Gabriel River at mouth.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
November, 1896	F. C. Finkle	5.6
December, 1896	do	3.0
January, 1897	do	10.1
February, 1897	do	18.3
March, 1897	do	18.9
April, 1897	do	10.2
May, 1897	do	8.9
June, 1897	do	7.7
July, 1897	do	8.6
August, 1897	do	3.9
September, 1897	do	4.1
April, 1900	J. B. Lippincott et al	1.69

Discharge measurements of North Fork of San Gabriel River.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
November, 1896	F. C. Finkle	3.7
December, 1896	do	3.6
January, 1897	do	10.8
February, 1897	do	17.0
March, 1897	do	19.4
April, 1897	do	13.8
May, 1897	do	11.2
June, 1897	do	7.1
July, 1897	do	5.9
August, 1897	do	4.1
September, 1897	do	3.9
April, 1900	J. B. Lippincott et al	1.43

Discharge measurements of Coldwater Creek, San Gabriel River, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
November, 1896	F. C. Fincle	4.1
December, 1896	do	4.2
January, 1897	do	11.3
February, 1897	do	19.1
March, 1897	do	17.8
April, 1897	do	11.3
May, 1897	do	9.8
June, 1897	do	8.3
July, 1897	do	6.5
August, 1897	do	5.1
September, 1897	do	5.0
April, 1900	J. B. Lippincott et al	1.46

Discharge measurements of Bear Creek, San Gabriel River, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
November, 1896	F. C. Fincle	3.3
December, 1896	do	3.4
January, 1897	do	9.1
February, 1897	do	24.7
March, 1897	do	23.9
April, 1897	do	17.3
May, 1897	do	14.1

Discharge measurements of Bear Creek, San Gabriel River, at point near mouth, Los Angeles County, Cal.

Date	Hydrographer.	Discharge.
		Sec.-feet.
June, 1897	F. C. Fincle	6.3
July, 1897	do	6.2
August, 1897	do	4.4
September, 1897	do	4.5
April, 1900	J. B. Lippincott et al	2.42

Discharge measurement of West Fork of San Gabriel River above Bear Creek, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
April, 1900	J. B. Lippincott et al	1.80

Discharge measurement of West Fork of San Gabriel above junction with East Fork, or Main River, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
August 23, 1898	J. B. Lippincott	2.67

Discharge measurement of East Fork of San Gabriel above junction with West Fork, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
August 23, 1898	J. B. Lippincott	7.11

Discharge measurement of San Gabriel River at junction of East and West forks.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
August 23, 1898	J. B. Lippincott	9.78
Do	do	[a] 8.42
Loss		1.36

[a] San Gabriel River at headworks of San Gabriel Power Company.

Discharge measurement of Cattle Canyon above Coldwater, San Gabriel River, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
April, 1900	J. B. Lippincott et al	0.32

Discharge measurements of San Gabriel River at various points in watershed below El Monte Narrows.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 3, 1898	F. H. Olmsted	2.52	Whittier ditch, El Monte road crossing.
Do	do	9.06	Temple ditch, left of Narrows flume.
Do	do	8.79	Baldwin ranch house road.
Do	do	6.18	Original river channel.
Do	do	3.36	Campers station.
Do	do	1.22	Puente ditch; 50 per cent of usual head in ditch.
Do	do	29.79	Old mission bridge (Rio Hondo).
	Total	60.92	

Discharge measurements of San Gabriel River at various points in watershed.

Date.	Hydrographer.	Locality.	Area of section.	Mean velocity.	Discharge.
1897.			*Sq. feet.*	*Ft. per sec.*	*Sec.-feet.*
Dec. 5	J. B. Lippincott	San Gabriel River, Los Angeles and Whittier road bridge.			106
1900.					
Aug. 7	S. G. Bennett	East Whittier ditch at El Monte road crossing.	4.08	1.4	5.71
Aug. 7	do	Killion's pumping plant, 4 wells near El Monte.	5.76	1.774	10.22
Aug. 7	do	Cameron or Sheep Creek ditch.	9.62	.25	2.46
Aug. 7	do	Rincon ditch	1.99	1.24	2.47
Aug. 7	do	Old Temple ditch	1.22	.98	1.20
Aug. 7	do	Cate ditch, near head	9.47	.92	8.71
Aug. 7	do	Standifer ditch	9.34	1.557	14.56
Aug. 7	do	Banta ditch	11.45	1.349	15.44
		Total, San Gabriel River at intake of Standifer and Banta ditches.			30.00
Aug. 8	do	Rodriguez ditch, near Old Mission.	1.20	1.67	2.00
Aug. 8	do	Rio Honda or Old San Gabriel, under Mission bridge.	31.42	.74	23.28
Aug. 8	do	Arroyo ditch	11.90	1.83	21.08
Aug. 8	do	Little Lake	.60	.37	.22
Aug. 8		[a] Agricultural ditch			Dry.
Sept. 17	W. W. Cockins	Bradbury ranch, Santa Anita, and Rose avenues.			1.44
Sept. 17	do	San Gabriel Sanitarium tunnel.			.04
Sept. 18	do	W. A. Highland, Rose avenue, Lamanda Park.			.10
Sept. 19	do	Chapman ranch, 2 wells pumped; 1 artesian well.			1.01
Sept. 19	do	Chapman ranch, 4 wells pumped.			1.90
Sept. 20	do	Chapman ranch, natural flow of ciénaga.			.07
Sept. 20	do	Chapman ranch dairy	.52	1.38	.72
		Chapman ranch, total			3.70

[a] San Gabriel River dry below this point.

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Hydrographer.	Locality.	Area of section.	Mean velocity.	Discharge.
1900.			*Sq. feet.*	*Ft. per sec.*	*Sec.-feet.*
Sept. 20	W. W. Cockins	Alhambra Water Co., weir No. 1.			2.58
Sept. 20	do	Alhambra Water Co., weir No. 2.			.34
		Total			2.92
Sept. 24	do	Santa Anita Canyon, natural flow.			.22
Sept. 24	do	Sierra Madre Water Co. (weir).			.145
Sept. 24	do	Remanettes east of Sierra Madre.	0.12	0.75	.09
Sept. 18	do	Monrovia Water Co., 3 wells pumped.			3.24
Sept. 24	do	Monrovia Canyon, to Monrovia Water Co. (weirs).			.428
		To Bradbury			.116
		Total			.544
Sept. 21	do	Duarte Mutual Improvement and Canal Co.			.78
Sept. 21	do	Beardsley Water Co			.44
Sept. 13	do	Morengo Water Co. Southern Pacific Co.'s Garfield station (weir).			1.82
Sept. 13	do	Morengo Water Co.'s weir in Morengo Canyon (weir).			.46
Sept. 13	do	Los Robles Water Co.'s reservoir (weir).			.31
Sept. 13	do	Reservoir at junction of Glenarm and Los Robles avenues, Pasadena (weir).			.068
Sept. 13	do	Graves & Bean tunnel	2.06	5.34	1.10
Sept. 14	do	Brick kiln between Molino and Hope streets, Pasadena.			.02
Sept. 14	do	Oak Knoll Park, Pasadena.	.096	3.53	.34
Sept. 14	do	Patton tunnel, near Kewen Lake.	.047	3.80	.18
Sept. 14	do	Patton's east canyon	.87	1.70	1.48
Sept. 17	do	Patton's east canyon, natural flow; pump not running.	.36	1.03	.37

Discharge measurements of San Gabriel River, etc.—Continued.

Date.	Hydrographer.	Locality.	Area of section.	Mean velocity.	Discharge.
1900.			*Sq. feet.*	*Ft. per sec.*	*Sec.-feet.*
Sept. 17	W. W. Cockins	Mission ditch, Patton ranch.			0.20
Sept. 14	do	Winston ranch	0.60	0.93	.56
Sept. 14	do	Shorbes ranch (weir)			.18
Sept. 15	do	Yoakham's ranch (weir).			.12
Sept. 15	do	Robert Liddel, San Pasqual and Shorb (weir).			.10
Sept. 15	do	R. W. Scoville (weir)			.07
Sept. 15	do	Mrs. Black, San Pasqual and Craig streets (weir).			.07
Sept. 15	do	Morningside ranch (weir).			.04
Sept. 27	do	Glendora, Azusa Irrigation Co.:			
		Massey well			1.50
		Paine well			.90
		Total			2.40
Sept. 27	Irwin F. Daniels	Wells in San Diemas wash:			
Sept. 27	do	Daty & Sons			1.80
Sept. 27	do	San Diemas Irrigation Co., F. D. Smith well			1.20
Sept. 27	do	Thacker well			.80
Sept. 27	do	Smith well (private).			.30
Sept. 27	do	Chapman well			.70
Sept. 27	do	Ruddock well			.50
Sept. 27	do	Artesian Belt Co., 2 wells.			1.60
Sept. 27	do	Azusa city well			.90
Sept. 27	do	Walker's well			.90
Sept. 27	do	Citizens' Water Co. (Covina).			.10
Sept. 27	do	Covina plant, Deacon well.			.44
Sept. 27	do	Natural flow, San Diemas Canyon.			.04
Sept. 27	do	Spark's well			.40
		Total			11.38

Discharge measurements of San Gabriel River at wells on Lordsburg Mesa.

Date.	Hydrographer.	Locality.	Area of section.	Mean velocity.	Discharge.
			Sq. feet.	*Ft. pr. sec.*	*Sec.-feet.*
Sept. 27	Irwin F. Daniels	Richards, 4 wells			1.52
Sept. 27	do	Sumner			.48
Sept. 27	do	Sheldon Bros			.30
Sept. 27	do	La Verne Land and Water Co.			.70
Sept. 27	do	Rodgers			.10
Sept. 27	do	True (5 days in 30)			.16
Sept. 27	do	Rodney Soper			.24
Sept. 27	do	Hayes & Stratton			.20
Sept. 27	do	Wallace			.16
Sept. 27	do	Mullard			.30
Sept. 27	do	Douglas & McQuilly			.76
Sept. 27	do	Norris			.30
Sept. 27	do	Williams Bros			.80
Sept. 27	do	Kulp (intermittent), south of Mesa avenue.			.20
Sept. 27	do	D. Fulton			.50
Sept. 27	do	Steves			.20
Sept. 27	do	Daniels & Overholtzer			1.34
Sept. 27	do	Massey, 2 wells			.54
Sept. 27	do	Hauser Bros			.76
Sept. 27	do	Moorwaw & Son			.50
Sept. 27	do	Sleider			.88
Sept. 27	do	Rutherford & Co			.40
Sept. 27	do	New Deal Water Co			.40
Sept. 27	do	Kiser			.90
		Total			12.64

Estimated monthly discharge of San Gabriel River at Azusa, Los Angeles County.

[Drainage area, 222 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1894.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
May	50	27	32	1,968	0.14	0.16
June	27	17	23	1,369	.10	.11
July	17	9	12	738	.05	.06
August	27	10	14	861	.06	.07
September	23	13	15	893	.07	.08
October	16	13	14	861	.06	.07
November 1 to 15	14	13	13	387	.06	.03
1895.						
August 8 to 31	47	38	42	1,999	.19	.17
September	39	29	32	1,904	.14	.16
October	32	27	29	1,783	.13	.15
November	50	29	40	2,380	.18	.20
December	45	37	42	2,582	.19	.22
1896.						
January	25	0	11	676	0.05	0.06
February	28	3	12	690	.05	.06
March	134	27	75	4,612	.34	.39
April	46	0	11	655	.05	.06
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	177	0	12	738	.05	.06
November	16	0	3	179	.01	.01
December	12	0	2	123	.01	.01
The year	177	0	11	7,673	.05	.65

NOTE.—During the summer months all this water is diverted by the canals. For 1894 and 1895 the above table is for the total discharge from the drainage basin. Subsequent to 1895 the table shows the separate flow in river and canals, except where combined and so stated.

Estimated monthly discharge of San Gabriel River at Azusa, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1897.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	130	5	40	2,484	0.181	0.201
February	1,710	46	332	18,420	1.494	1.555
March	1,765	275	448	27,572	2.020	2.329
April	345	141	259	15,417	1.166	1.301
May	141	28	82	5,042	.369	.420
June	28	.2	5	274	.021	.024
July	0	0	0	0	0	.000
August	0	0	0	0	0	.000
September	0	0	0	0	0	.000
October	1,600	0	72	4,458	.322	.372
November	15	.4	8	475	.036	.040
December	5	3.0	4	221	.016	.018
The year	1,765	0	104	74,302	.469	6.260
1898.						
January	31	0	14	863	0.06	0.07
February	41	0	11	622	.05	.05
March	1	0	0.03	2	0	0
April	0	0	0	0	0	0
May	63	0	4.5	277	.02	.02
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	63	0	2.5	1,764	.01	.14

Estimated monthly discharge of San Gabriel River at Azusa, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	16	0	1.2	74	0.005	0.005
February	0	0	0	0	0	0
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	13	0	.42	26	0.002	.002
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	16	0	.13	100	.007	.007
1900.						
January	49	0	2	123	0.01	0.01
February	0	0	0	0	0	0
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	38	0	2	123	.01	.01
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	5,168	0	172	10,245	0.77	0.85
December	0	0	0	0	0	0
The year	5,168	0	15	10,481	.07	.87

Estimated monthly discharge of San Gabriel River at Azusa, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,450	0	111	6,825	0.50	0.58
February	2,600	70	613	34,044	2.76	2.87
March	370	80	158	9,715	.71	.82
April	75	13	43	2,559	.19	.21
May	200	18	55	3,382	.25	.29
June	27	0	7	417	.03	.03
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	70	0	3	184	.01	.01
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	2,600	0	83	57,126	.37	4.81
1902.						
January	0	0	0	0	----	----
February	57	0	3	167	----	----
March	318	4	38	2,337	----	----
April	37	0	7	417	----	----
May	0	0	0	0	----	----
June	0	0	0	0	----	----
July	0	0	0	0	----	----
August	0	0	0	0	----	----
September	0	0	0	0	----	----
October	0	0	0	0	----	----
November	0	0	0	0	----	----
December	0	0	0	0	----	----
The year	318	0	4	2,921	----	----

Estimated monthly discharge of San Gabriel canals at Azusa, Los Angeles County.

[Drainage area, 222 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	26	26	26	1,599	0.12	0.14
February	34	26	30	1,726	.14	.15
March	43	35	36	2,214	.16	.18
April	45	40	43	2,559	.19	.21
May	42	29	36	2,214	.16	.18
June	27	13	19	1,131	.09	.10
July	15	9	12	738	.05	.06
August	36	9	14	861	.06	.07
September	19	11	13	774	.06	.07
October	17	10	11	676	.05	.06
November	24	15	17	1,012	.08	.09
December	25	18	20	1,230	.09	.10
The year	45	9	23	16,734	.10	1.41
1897.						
January	22	13	17.56	1,072	0.079	0.091
February	20	3	13.10	726	.059	.061
March	21	0	17.14	1,051	.077	.089
April	60	15	35.30	2,102	.159	.177
May	68	55	62.97	3,810	.284	.328
June	71	54	63.20	3,759	.285	.317
July	52	27	38.13	2,343	.171	.197
August	34	22	26.45	1,613	.118	.136
September	23	18	20.66	1,226	.088	.098
October	26	10	18.03	1,106	.081	.093
November	29	16	23.30	1,385	.105	.109
December	29	25	26.84	1,648	.121	.139
The year	71	0	30.20	21,831	.136	1,835

Estimated monthly discharge of San Gabriel canals at Azusa, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1898.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	32	23	26	1,591	0.12	0.14
February	34	10	29	1,618	.13	.14
March	48	28	35	2,129	.16	.18
April	37	25.3	33	1,950	.15	.17
May	45	20.0	32	1,947	.14	.16
June	30	14.5	19	1,159	.09	.10
July	14	9.0	11	672	.05	.06
August	9	5.0	7	456	.03	.03
September	10	6.1	8	467	.04	.04
October	10	7.5	9	533	.04	.04
November	11	8.0	10	580	.04	.04
December	18	11.7	14	832	.06	.07
The year	48	5.0	19.4	13,934	.09	1.17
1899.						
January	33	15	21.8	1,340	0.098	0.115
February	27	20	22.0	1,244	.102	.106
March	40	18	26.0	1,623	.119	.137
April	28	16	21.0	1,262	.096	.107
May	17	12	14.0	842	.062	.071
June	22	5	10.0	565	.043	.048
July	4	3	4.0	221	.016	.018
August	6	4	5.0	295	.022	.025
September	6	3	4.0	220	.019	.021
October	26	4	11.1	683	.050	.058
November	24	10	14.0	847	.064	.071
December	39	16	20.0	1,247	.091	.105
The year	40	3	14.4	10,389	.065	.882

Recorded monthly discharge of San Gabriel canals at Azusa, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1900.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	50	22	30	1,845	0.14	0.16
February	23	18	20	1,111	.09	.09
March	30	16	20	1,230	.09	.10
April	26	13	17	1,012	.08	.09
May	56	16	35	2,152	.16	.18
June	22	8	15	893	.07	.08
July	10	4	6	369	.03	.03
August	5	4	4	246	.02	.02
September	6	3	4	238	.02	.02
October	6	4	5	307	.02	.02
November	55	5	14	833	.06	.07
December 1 to 16	53	31	40	1,269	.18	.11
The year	55	3	18	11,505	.08	.97
1901.						
January	90	0	58	3,566	0.26	0.30
February	70	5	67	3,721	.30	.31
March	70	35	63	3,874	.28	.32
April	84	55	67	3,987	.30	.33
May	72	59	66	4,058	.30	.35
June	66	41	56	3,332	.25	.28
July	41	24	30	1,845	.14	.16
August	27	15	20	1,230	.09	.10
September	20	15	17	1,012	.08	.09
October	64	0	21	1,291	.09	.10
November	50	29	32	1,904	.14	.16
December	30	26	27	1,660	.12	.14
The year	90	0	44	31,480	.20	2.64

Estimated monthly discharge of San Gabriel canals at Azusa, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1902.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	51	24	28	1,722		
February	63	27	34	1,888		
March	62	55	61	3,750		
April	62	46	59	3,510		
May	48	30	39	2,398		
June	29.5	13.5	20	1,190		
July	17	7.5	11	676		
August	8.5	6	7	430		
September	6	4.5	5	298		
October	10.5	5.5	7	430		
November	62	7.5	19	1,131		
December	68	16	32	1,968		
The year	68	4.5	27	19,391		

Estimated monthly discharge of San Gabriel River and canals at Azusa, Los Angeles County.

[Drainage area, 222 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	51	26	37	2,275	0.17	0.20
February	61	36	41	2,358	.18	.19
March	169	37	111	6,825	.50	.58
April	91	40	54	3,213	.24	.27
May	40	29	36	2,214	.16	.18
June	27	13	19	1,131	.09	.10
July	15	9	12	738	.05	.06
August	36	9	14	861	.06	.07
September	19	11	13	774	.06	.07
October	188	10	24	1,476	.11	.13
November	40	15	19	1,131	.09	.10
December	37	17	22	1,353	.10	.12
The year	188	9	34	24,349	.15	2.07

Estimated monthly discharge of San Gabriel River and canals at Azusa, Los Angeles County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1897.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	147	25	57.9	3,617	0.260	0.292
February	1,713	64	344.8	19,146	1.553	1.579
March	1,765	294	465.6	28,623	2.097	2.418
April	370	201	294.4	17,519	1.325	1.478
May	196	94	145.0	8,851	.653	.748
June	91	54	67.8	4,033	.306	.341
July	52	27	38.1	2,343	.171	.197
August	34	22	26.4	1,613	.118	.136
September	23	18	20.7	1,226	.088	.098
October	1,640	22	90.5	5,564	.403	.465
November	34	31	33.3	1,860	.141	.149
December	34	28	30.5	1,875	.137	.158
The year	1,765	18	134.6	96,270	.604	8.059
1898.						
January	63	28	40	2,453	0.18	0.20
February	70	32	40	2,241	.18	.19
March	48	28	35	2,131	.16	.18
April	37	25.3	33	1,950	.15	.17
May	83	25.0	36	2,223	.16	.19
June	30	14.5	19	1,159	.09	.10
July	14	9.0	11	672	.05	.06
August	9	5.0	7	456	.03	.04
September	10	6.1	8	467	.04	.04
October	10	7.5	9	533	.04	.05
November	11	8.0	10	580	.04	.05
December	18	11.7	14	832	.06	.07
The year	83	5.0	22	15,697	.10	1.34

Estimated monthly discharge of San Gabriel River and canals at Azusa, Los Angeles County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	33	15	23	1,414	0.104	0.120
February	28	20	22	1,244	.102	.106
March	40	18	26	1,623	.119	.137
April	28	16	21	1,262	.096	.107
May	17	12	14	842	.062	.071
June	22	5	10	565	.043	.048
July	4	3	4	221	.016	.018
August	6	4	5	295	.022	.025
September	6	3	4	220	.019	.021
October	26	4	11	709	.050	.058
November	24	10	14	847	.064	.071
December	39	16	20	1,247	.091	.105
The year	40	3	5	10,489	.065	.887
1900.						
January	89	22	32	1,968	0.14	0.16
February	23	18	20	1,111	.09	.09
March	30	16	20	1,230	.09	.10
April	26	13	17	1,012	.08	.09
May	86	16	37	2,275	.17	.20
June	22	8	15	893	.07	.08
July	10	4	6	369	.03	.03
August	5	4	4	246	.02	.02
September	6	3	4	238	.02	.02
October	6	4	5	307	.02	.02
November	5,200	5	186	11,068	.84	.93
December 1 to 16	53	31	40	1,269	.18	.11
The year	5,200	3	32	21,986	.15	1.85

Estimated monthly discharge of San Gabriel River and canals at Azusa, Los Angeles County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,450	28	169	10,391	0.76	0.87
February	2,605	137	680	37,765	3.06	3.19
March	440	135	221	13,589	1.00	1.15
April	130	95	110	6,545	.50	.56
May	272	83	121	7,440	.55	.63
June	93	41	63	3,749	.28	.31
July	41	24	30	1,845	.14	.16
August	27	15	20	1,230	.09	.10
September	20	15	17	1,012	.08	.09
October	122	15	24	1,476	.11	.13
November	50	29	32	1,904	.14	.16
December	30	26	27	1,660	.12	.14
The year	2,605	15	126	88,606	.57	7.49
1902.						
January	51	24	28	1,722	0.13	0.15
February	120	38	37	2,055	.17	.17
March	378	63	99	6,087	.45	.52
April	99	48	66	3,927	.30	.33
May	48	30	39	2,398	.17	.20
June	29.5	13.5	20	1,190	.09	.10
July	17	7.5	11	676	.05	.06
August	8.5	6	7	430	.03	.03
September	6	4.5	5	298	.02	.02
October	10.5	5.5	7	430	.03	.03
November	80	7.5	19	1,131	.09	.10
December	68	16	32	1,968	.14	.16
The year	378	4.5*	31	22,312	.14	1.87

SAN GREGORIO CREEK.

Discharge measurement of San Gregorio Creek, San Mateo County.

Date.	Hydrographer.	Discharge.	Locality.
1893.		*Sec. ft.*	
ct. 17	W. W. Brier	6.49	One-third mile above San Gregorio.

SAN JOAQUIN RIVER.

The headwater tributaries of this river receive the drainage from he crests of the Sierra Nevada north of Mount Whitney. The fall f the river is rapid, with many favorable locations for power devel- pment, and in one case advantage has been taken of the fall on the Vorth Fork, and a power plant constructed, developing electric power or transmission to Fresno and Hanford, Cal. During 1899 a second torage reservoir was under course of construction on the North 'ork, which will tend further to regulate the flow of the river. No ermanent diversions above the gaging station are made, but the 'ater is extensively used below for irrigation purposes. The gage rod t the station was established by the Southern Pacific Railway Company 1 1879. The old trestle bridge was torn down by the railroad company uring 1899 and a new iron structure was erected in its place. This ecessitated a new gage rod, which was set to the datum of the old age and bolted to the western side of the central concrete pier. The ench mark is a nail in a post at the south end of the bridge on the est side, 0.2 foot above the ground and marked "B. M." It is at n elevation of 24.12 feet above gage datum. The channel for some istance above and below the bridge is straight, and the water has a niform velocity. The right bank is high, rocky, and steep. The ed of the stream is of sand and gravel.

ischarge measurements of San Joaquin River at Herndon, Fresno County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
1895.		*Feet.*	*Sec.-feet.*
un. 9	A. P. Davis and J. B. Lippincott	4	1,995
ar. 22	J. B. Lippincott	3.85	1,938
ay 5	do	6.65	7,419
ne 23	do	8.00	11,225
ug. 31	do	3.00	677
ct. 11	do	2.6	332
ov. 25	do	2.55	270
1896.			
pr. 13	J. A. Vogleson	4.1	2,406
ne 11	J. B. Lippincott	9.33	15,942
ov. 2	do	2.75	424

Discharge measurements of San Joaquin River at Herndon, etc.—Continued.

Date	Hydrographer	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
1897.			
Feb. 14	J. B. Lippincott	3.58	1,117
May 31	do	8.60	10,500
July 16	A. Q. Campbell	4.5	3,223
Sept. 8	do	2.66	271
Nov. 2	do	2.92	515
Dec. 21	J. B. Lippincott	3.00	699
1898.			
Apr. 19	J. B. Lippincott	5.42	4,162
May 30	do	4.58	2,235
July 28	do	3	611
Sept. 2	do	2.52	328
Dec. 20	do	2.5	287
1899.			
Mar. 5	J. B. Lippincott	3.25	786
Apr. 18	S. G. Bennett	6.34	5,310
May 13	do	[a]7	7,435
June 2	do	5.76	4,177
June 27	do	4.90	2,922
Aug. 1	do	3.32	743
Sept. 8	do	2.67	196
1900.			
Feb. 2	J. B. Lippincott	3.25	1,003
Apr. 3	S. G. Bennett	4.66	2,641
May 15	do	5.91	4,448
June 18	do	5.67	3,710
Aug. 9	do	2.83	466
Sept. 1	do	2.50	246
Sept. 28	do	2.33	197
Dec. 30	do	3.33	614
1901.			
Jan. 30	S. G. Bennett	4	1,357
Mar. 2	do	6.8	6,179
Apr. 3	do	5	3,357
July 31	do	5.67	3,909
Oct. 16	do	2.25	359
1902.			
May 14	S. G. Bennett	7.35	7,381
Sept. 11	L. M. Lawson		329

[a] Gage height at beginning, 6.75; at ending, 7.25.

Discharge measurements of San Joaquin River, Fresno County.

Date.	Hydrographer.	Discharge.	Locality.
1899.		*Sec.-feet.*	
Sept. 8	S. G. Bennett	269	500 feet above Pollasky Bridge.
1900.			
Sept. 28	S. G. Bennett	188	Do.
Sept. 28	J. S. Eastwood	188	
1901.			
Oct. 16	S. G. Bennett	315	At Pollasky Ford.
1900.			
Aug. 31	E. G. Hamilton	31	South Fork at Blaney Meadows.
1902.			
Sept. 27	S. G. Bennett	589	Above railroad bridge near Lathrop, San Joaquin County.
Sept. 6	E. T. Perkins	.7	Granite Creek 100 feet below sheep bridge.
Sept. 7	do	342	150 yards below junction Jackass Creek.
Sept. 7	do	3	Jackass Creek 50 feet above junction with San Joaquin.
Sept. 8	do	148	Middle Fork 100 yards above Miller Bridge.
Sept. 10	do	51	Mono Creek at Trail Crossing.
Sept. 10	do	107	South Fork at Trail Crossing.
Sept. 10	do	9	Big Creek at dam site of J. S. Eastwood.
Sept. 8	L. M. Lawson	309	Pollasky.
Sept. 9	do	18	Canal at Reservoir, North Fork, at San Joaquin power house.
Sept. 10	do	310	San Joaquin Electric Co.'s power house.
Sept. 12	do	25	Below dam at Mendota.
Sept. 12	do	260	Miller and Lux Canal at small dam.
Sept. 12	do	265	Miller and Lux canal at bridge near dredger.

Estimated monthly discharge of San Joaquin River at Hamptonville, Fresno County.

[Drainage area, 1,637 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November	------	------	330	19,636	0.20	0.22
December	------	------	410	25,210	.25	.29
1879.[a]						
January	3,010	370	609	37,446	0.37	0.43
February	5,420	620	1,276	70,865	.78	.81
March	3,340	1,300	1,953	120,085	1.19	1.37
April	8,560	2,360	3,849	229,031	2.35	2.62
May	10,030	2,850	5,302	326,007	3.24	3.74
June	11,640	4,200	6,379	379,576	3.90	4.35
July	4,460	1,300	2,303	141,606	1.41	1.63
August	1,300	550	786	48,329	.48	.55
September	480	310	381	22,671	.23	.26
October	480	260	373	22,935	.23	.27
November	420	370	411	24,456	.25	.28
December	4,700	700	1,140	70,096	.70	.81
The year	11,640	260	2,063	1,493,103	1.26	17.12
1880.[a]						
January	1,020	770	825	50,727	0.50	0.58
February	2,360	770	942	54,184	.57	.61
March	1,640	1,120	1,229	75,568	.75	.86
April	15,580	1,300	4,846	288,357	2.96	3.30
May	25,000	5,420	13,170	809,792	8.05	9.28
June	25,600	14,180	18,120	1,078,214	11.07	12.35
July	14,650	3,350	8,010	492,516	4.89	5.64
August	4,700	840	1,730	106,374	1.06	1.22
September	840	550	734	43,676	.45	.50
October	480	380	422	25,948	.26	.30
November	450	370	380	22,612	.23	.26
December	6,730	395	2,001	123,037	1.22	1.41
The year	25,600	370	4,367	3,171,005	2.67	36.31

[a] Authority, California State engineering department.

Estimated monthly discharge of San Joaquin River at Hamptonville, Fresno County—Continued.

Month.	Discharge.			Total discharge.	Run-off	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1881.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	59,800	1,024	3,856	237,096	2.35	2.71
February	22,450	2,440	6,340	352,106	3.87	4.03
March	6,570	2,440	2,855	175,547	1.74	2.01
April	13,250	5,900	8,008	476,509	4.89	5.45
May	16,500	5,900	9,095	559,230	5.56	6.41
June	9,230	4,300	5,948	353,931	3.63	4.05
July	5,180	2,200	3,064	188,398	1.87	2.16
August	1,640	760	1,260	77,474	.77	.89
September	760	490	584	34,750	.36	.40
October	490	430	463	28,469	.28	.32
November	530	380	461	27,431	.28	.31
December	2,740	340	632	38,860	.39	.45
The year	59,800	340	3,547	2,549,801	2.17	29.19
1882.[a]						
January	330	290	303	18,631	0.19	0.22
February	520	280	330	18,327	.20	.21
March	3,890	340	1,522	93,584	.93	1.07
April	7,360	2,540	3,409	202,849	2.08	2.32
May	12,860	7,360	8,850	544,165	5.41	6.23
June	13,980	4,280	7,867	468,119	4.81	5.36
July	6,900	700	2,918	179,421	1.78	2.05
August	1,630	450	591	36,339	.36	.42
September [b]			240	14,281	.15	.17
October [b]			564	34,679	.34	.39
November [b]			490	29,157	.30	.33
December [b]			320	19,676	.20	.23
The year			2,370	1,659,228	1.40	19.00

[a] Authority, California State engineering department.
[b] Estimated from previous measurements and neighboring streams.

Estimated monthly discharge of San Joaquin River at Hamptonville, Fresno County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.[a]	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January [b]			320	19,676	0.20	0.23
February [b]			320	17,771	.20	.21
March [b]			1,150	70,711	.70	.81
April [b]			2,130	126,744	1.30	1.45
May [b]			7,370	453,164	4.50	5.19
June [b]			6,220	370,116	3.80	4.24
July [b]			1,470	90,387	.90	1.04
August [b]			490	30,129	.30	.35
September [b]			410	24,397	.25	.28
October [b]			330	20,291	.20	.23
November [b]			250	14,876	.15	.17
December [b]			250	15,372	.15	.17
The year			1,726	1,253,634	1.05	14.37
1884.[a]						
January [b]			410	25,210	0.25	0.29
February [b]			2,460	141,501	1.50	1.62
March [b]			4,090	251,484	2.50	2.88
April [b]			3,270	194,578	2.00	2.23
May [b]			8,190	503,583	5.00	5.76
June [b]			16,400	975,868	10.02	11.18
July [b]			13,100	805,488	8.00	9.22
August [b]			3,270	201,064	2.00	2.31
September [b]			980	58,314	.60	.67
October [b]			820	50,420	.50	.58

[a] Authority, California State engineering department.
[b] Estimated from previous measurements and neighboring streams.

Estimated monthly discharge of San Joaquin River at Herndon, Fresno County.

[Drainage area, 1,637 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	11,225	1,260	2,881	177,146	1.76	2.03
February	8,500	909	2,568	142,619	1.57	1.63
March	9,318	1,554	2,779	170,874	1.70	1.96
April	9,863	3,354	5,834	347,147	3.56	3.97
May	19,960	5,100	13,124	806,963	8.02	9.24
June	14,250	7,250	10,674	635,147	6.52	7.27
July	8,000	2,148	4,528	278,416	2.77	3.20
August	2,301	793	1,417	87,128	.87	1.00
September	8,500	260	1,085	64,562	.66	.73
October	1,260	260	420	25,825	.26	.30
November	426	260	362	21,540	.22	.24
December	677	260	373	22,935	.23	.26
The year	19,960	260	3,837	2,780,302	2.35	31.83
1896.						
January	12,800	250	2,119	130,335	1.29	1.49
February	1,750	950	1,177	67,696	.72	.77
March	12,176	1,180	2,612	160,649	1.60	1.84
April	5,648	1,920	2,675	159,192	1.64	1.83
May	18,800	2,560	5,394	331,700	3.30	3.81
June	16,920	6,544	11,799	702,106	7.21	8.00
July	8,080	1,600	4,177	256,865	2.55	3.04
August	1,300	700	1,048	64,463	.64	.74
September	1,180	80	534	31,817	.33	.37
October	700	80	167	10,275	.10	.12
November	2,390	430	697	41,492	.43	.48
December	1,750	430	666	40,957	.41	.47
The year	18,800	80	2,756	1,997,547	1.69	22.96

Estimated monthly discharge of San Joaquin River at Herndon, Fresno County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1897.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,180	535	655	40,275	0.40	0.46
February	15,660	1,180	2,598	144,286	1.59	1.66
March	4,600	1,675	2,325	142,960	1.42	1.64
April	11,708	2,305	6,541	389,216	4.00	4.46
May	18,600	9,565	13,545	832,855	8.27	9.54
June	12,332	2,390	5,862	348,812	3.57	3.98
July	4,300	1,300	2,493	153,290	1.52	1.75
August	1,300	590	898	55,216	.55	.63
September	535	105	227	13,507	.14	.16
October	820	105	279	17,155	.17	.20
November	4,300	120	872	51,887	.53	.59
December	4,000	[a]513	995	61,180	.61	.70
The year	18,600	105	3,108	2,250,639	1.90	25.77
1898.						
January	763	530	658	40,459	0.40	0.46
February	1,425	530	842	46,762	.51	.54
March	1,242	763	908	55,831	.56	.64
April	5,846	1,018	2,944	175,180	1.80	2.01
May	5,141	2,262	3,206	197,131	1.96	2.26
June	3,744	1,730	2,718	161,732	1.66	1.85
July	1,730	530	959	58,967	.59	.68
August	610	350	480	29,514	.29	.33
September	1,882	220	363	21,600	.22	.24
October	763	350	509	31,297	.31	.36
November	350	290	308	18,327	.19	.21
December	1,181	240	384	23,611	.24	.26
The year	5,846	220	1,190	860,411	.73	9.84

[a] Minimum of 60 second-feet given in Nineteenth Ann. Rept. is error.

Estimated monthly discharge of San Joaquin River at Herndon, Fresno County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,170	170	463	28,469	0.28	0.32
February	1,060	350	645	35,821	.39	.41
March	16,206	692	2,689	165,341	1.64	1.89
April	7,354	2,030	4,233	251,880	2.59	2.88
May	7,090	1,830	3,730	229,350	2.28	2.63
June	9,070	2,620	5,700	339,173	3.48	3.88
July	3,105	955	1,664	104,284	1.02	1.18
August	745	250	428	26,317	.26	.30
September	220	70	152	9,045	.09	.10
October	776	69	214	13,158	.13	.15
November	1,175	130	565	33,620	.34	.39
December	4,775	220	1,018	62,595	.62	.71
The year	16,206	69	1,792	1,299,053	1.09	14.84
1900.						
January	15,932	745	2,244	137,978	1.37	1.58
February	745	355	534	29,657	.33	.34
March	2,780	640	1,748	107,480	1.07	1.23
April	2,780	1,520	2,060	122,578	1.26	1.41
May	9,730	2,170	5,725	352,016	3.50	4.04
June	8,674	3,620	5,728	340,840	3.50	3.90
July	3,445	630	1,642	100,962	1.00	1.15
August	630	240	390	23,980	.24	.28
September	240	180	204	12,139	.13	.14
October	990	180	451	27,730	.28	.32
November	20,780	240	1,834	109,130	1.12	1.25
December	1,285	745	1,033	63,517	.63	.72
The year	20,780	180	1,966	1,428,007	1.20	16.36

Estimated monthly discharge of San Joaquin River at Herndon, Fresno County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	21,372	810	3,506	215,576	2.14	2.47
February	12,940	1,550	4,983	276,742	3.04	3.17
March	6,830	2,480	4,191	257,695	2.56	2.95
April	12,400	1,930	4,680	278,479	2.86	3.18
May	17,870	4,775	10,935	672,367	6.68	7.71
June	15,662	7,882	11,998	713,930	7.33	8.17
July	14,294	3,110	3,466	213,116	2.12	2.45
August	5,850	500	2,373	145,910	1.45	1.67
September	500	360	399	23,742	.24	.27
October	2,480	340	489	30,067	.30	.35
November	1,550	500	702	41,772	.43	.48
December	2,060	460	872	53,617	.53	.61
The year	21,372	340	4,050	2,923,013	2.47	33.48

Discharge measurements of Chiquita San Joaquin River, Madera County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Sept. 27, 1900	J. S. Eastwood	22.6

SAN JOSE CREEK.

Discharge measurements of San Jose Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Aug. —, 1889	G. F. Wright	0.27

The following measurements of San Jose Creek were made by Charles J. Johansen for the Pacific Improvement Company. The pipe line along the West Fork of San Jose Creek was not carrying water in the year 1890.

The point of measurement of the West Fork was a short distance above its junction with the East Fork, or main stream. The main stream, or East Fork, of San Jose Creek was gaged a short distance above its junction with the West Fork, and the pipe line along this stream was not carrying water in the year 1890.

List of discharge measurements of San Jose Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
Feb. 4	Charles J. Johansen	1.57	West Fork at mouth.
Feb. 15	do	.54	Do.
Feb. 28	do	.94	Do.
Mar. 1	do	.60	Do.
Mar. 3	do	.60	Do.
Mar. 5	do	.54	Do.
Mar. 7	do	.54	Do.
Mar. 9	do	.50	Do.
Mar. 11	do	.50	Do.
Mar. 13	do	.44	Do.
Mar. 15	do	.44	Do.
Mar. 17	do	.44	Do.
Mar. 19	do	.50	Do.
Mar. 21	do	.44	Do.
Mar. 23	do	.40	Do.
Mar. 25	do	.40	Do.
Mar. 27	do	.40	Do.
Mar. 29	do	.40	Do.
Mar. 31	do	.40	Do.
Apr. 2	do	.40	Do.
Apr. 4	do	.40	Do.
Apr. 6	do	.40	Do.
Apr. 8	do	.40	Do.
Apr. 10	do	.35	Do.
Apr. 12	do	.40	Do.
Apr. 14	do	.40	Do.
Apr. 15	do	.32	Do.
Apr. 17	do	.29	Do.
Apr. 19	do	.32	Do.
Apr. 21	do	.32	Do.
Apr. 23	do	.32	Do.
Apr. 25	do	.32	Do.
Apr. 27	do	.32	Do.
Apr. 29	do	.35	Do.

List of discharge measurements of San Jose Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
May 1	Charles J. Johanson	0.32	West Fork at mouth.
May 3	do	.26	Do.
May 5	do	.32	Do.
May 7	do	.32	Do.
May 9	do	.26	Do.
May 11	do	.26	Do.
May 12	do	.23	Do.
May 13	do	.26	Do.
May 15	do	.23	Do.
May 17	do	.26	Do.
May 19	do	.26	Do.
May 21	do	.23	Do.
May 23	do	.23	Do.
May 25	do	.23	Do.
May 27	do	.23	Do.
May 29	do	.23	Do.
May 31	do	.21	Do.
June 2	do	.21	Do.
June 4	do	.21	Do.
June 6	do	.21	Do.
June 8	do	.18	Do.
June 10	do	.23	Do.
June 12	do	.21	Do.
June 14	do	.21	Do.
June 16	do	.27	Do.
June 18	do	.21	Do.
June 20	do	.19	Do.
June 22	do	.21	Do.
June 24	do	.17	Do.
June 26	do	.19	Do.
June 28	do	.20	Do.
June 30	do	.20	Do.
July 2	do	.17	Do.
July 4	do	.17	Do.
July 6	do	.18	Do.
July 8	do	.17	Do.
July 10	do	.17	Do.
July 12	do	.17	Do.
July 14	do	.16	Do.

List of discharge measurements of San Jose Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
July 16	Charles J. Johansen	0.16	West Fork at mouth.
July 18	do	.14	Do.
July 20	do	.16	Do.
July 22	do	.14	Do.
July 24	do	.17	Do.
July 26	do	.16	Do.
July 28	do	.17	Do.
July 30	do	.17	Do.
Aug. 1	do	.17	Do.
Aug. 2	do	.17	Do.
Aug. 3	do	.17	Do.
Aug. 4	do	.17	Do.
Aug. 6	do	.17	Do.
Aug. 8	do	.17	Do.
Mar. 1	do	6.38	East Fork above West Fork.
Mar. 3	do	5.76	Do.
Mar. 5	do	5.17	Do.
Mar. 7	do	4.88	Do.
Mar. 9	do	4.59	Do.
Mar. 11	do	4.03	Do.
Mar. 13	do	3.76	Do.
Mar. 15	do	3.51	Do.
Mar. 17	do	3.00	Do.
Mar. 19	do	3.51	Do.
Mar. 21	do	5.11	Do.
Mar. 23	do	4.59	Do.
Mar. 25	do	4.59	Do.
Mar. 27	do	4.31	Do.
Mar. 29	do	4.31	Do.
Mar. 31	do	4.03	Do.
Apr. 2	do	4.03	Do.
Apr. 4	do	3.51	Do.
Apr. 6	do	3.51	Do.
Apr. 8	do	3.51	Do.
Apr. 10	do	3.25	Do.
Apr. 12	do	3.00	Do.
Apr. 14	do	3.00	Do.
Apr. 15	do	1.97	Do.
Apr. 17	do	2.24	Do.

List of discharge measurements of San Jose Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
Apr. 19	Charles J. Johansen	2.10	East Fork above West Fork.
Apr. 21	do	2.10	Do.
Apr. 23	do	1.97	Do.
Apr. 25	do	1.97	Do.
Apr. 27	do	1.97	Do.
Apr. 29	do	2.10	Do.
May 1	do	1.97	Do.
May 3	do	1.72	Do.
May 5	do	1.72	Do.
May 7	do	1.72	Do.
May 9	do	1.72	Do.
May 11	do	1.72	Do.
May 12	do	1.18	Do.
May 13	do	1.59	Do.
May 15	do	1.47	Do.
May 17	do	1.47	Do.
May 19	do	1.47	Do.
May 21	do	1.19	Do.
May 23	do	1.19	Do.
May 25	do	1.25	Do.
May 27	do	1.19	Do.
May 29	do	1.19	Do.
May 31	do	1.19	Do.
June 2	do	1.12	Do.
June 4	do	.94	Do.
June 6	do	.88	Do.
June 8	do	.91	Do.
June 10	do	.91	Do.
June 12	do	.94	Do.
June 14	do	1.00	Do.
June 16	do	1.12	Do.
June 18	do	1.06	Do.
June 20	do	1.00	Do.
June 22	do	.82	Do.
June 24	do	.82	Do.
June 26	do	.88	Do.
June 28	do	.94	Do.
June 30	do	.82	Do.
July 2	do	.76	Do.

List of discharge measurements of San Jose Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
July 4	Charles J. Johansen	0.76	East Fork above West Fork.
July 6	do	.79	Do.
July 8	do	.76	Do.
July 10	do	.71	Do.
July 12	do	.73	Do.
July 14	do	.70	Do.
July 16	do	.70	Do.
July 18	do	.65	Do.
July 20	do	.62	Do.
July 22	do	.60	Do.
July 24	do	.60	Do.
July 26	do	.63	Do.
July 28	do	.54	Do.
July 30	do	.60	Do.
Aug. 1	do	.63	Do.
Aug. 2	do	.63	Do.
Aug. 3	do	.63	Do.
Aug. 4	do	.63	Do.
Aug. 6	do	.63	Do.
Aug. 8	do	.63	Do.
Aug. 11	do	.88	Do.
Aug. 13	do	.88	Do.
Aug. 15	do	.82	Do.
Aug. 17	do	.65	Do.
Aug. 19	do	.60	Do.
Aug. 21	do	.60	Do.
Aug. 23	do	.60	Do.
Aug. 25	do	.65	Do.
Aug. 27	do	.65	Do.
Aug. 29	do	.60	Do.
Aug. 31	do	.60	Do.
Sept. 2	do	.57	Do.
Sept. 4	do	.40	Do.
Sept. 6	do	.44	Do.
Sept. 8	do	.57	Do.
Sept. 10	do	.44	Do.
Sept. 12	do	.54	Do.
Sept. 14	do	.50	Do.

List of discharge measurements of San Jose Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
Sept. 15	Charles J. Johansen	0.60	East Fork above West Fork.
Sept. 18	do	.60	Do.
Sept. 20	do	.65	Do.
Sept. 22	do	.60	Do.
Sept. 24	do	.71	Do.
Sept. 26	do	.71	Do.
Sept. 28	do	.82	Do.
Sept. 30	do	.71	Do.
Oct. 2	do	.71	Do.
Oct. 4	do	.68	Do.
Oct. 6	do	.60	Do.
Oct. 7	do	.61	Do.

SAN LUIS REY RIVER.

Discharge measurements of San Luis Rey River, San Diego County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
June 20, 1899	S. G. Bennett	1.04	Headworks Escondido Irrigation District canal.
Aug. 19, 1900	H. N. Savage	2.00	Do.
Sept. —, 1899	do	2.50	4 miles east of Sicklers Mill, Pala
Sept. —, 1899	do	[a] 3.50	
Apr. 2, 1900	do	10.00	Do.
May —, 1894	E. F. Tabor	6.716	
Oct. —, 1894	do	4	
Dec. 8, 1894	do	10	
Dec. 20, 1894	do	240	
Jan. 15, 1895	do	5,000	
Mar. 8, 1895	do	152	
Apr. 11, 1895	do	100	
Apr. 17, 1895	do	72	
May 10, 1895	do	39	
May 19, 1895	do	19	

[a] H. N. Savage states this to be minimum prior to September, 1899.

SAN MATEO CREEK.

San Francisco obtains its domestic water supply from a series of impounding reservoirs located in the southern portion of the peninsula between San Francisco Bay and the Pacific Ocean. The drainage basin of these reservoirs ranges in elevation from 250 to 1,800 feet, with an average of about 750 feet. The hills are undulating. There is a limited growth of timber on the northern slopes near the summit, but a large amount of brush covers other portions of the basin. On the southern slopes and crests the hills are frequently bare of brush, but are covered with grasses. The Spring Valley Water Company owns the entire area of the drainage basin and protects the forest covering, not even permitting grazing within its limits. Mr. Herman Schussler, chief engineer of the water company, has furnished this office with a statement of the rainfall and run-off of the drainage basins which contribute to the water supply under the control of the company. The table given below extends from 1869 to 1899, and shows the seasonal rainfall, together with the percentage collected in the reservoirs. The record is therefore thirty years in length. It is by far the oldest table of run-off in the State, and for this reason is of unusual value. The seasonal year rather than the calendar is given. Column No. 1 shows the year; column No. 2 the inches of rainfall in the respective basins; column No. 3 the percentage of this rainfall which is caught and delivered, the evaporation being deducted. The portion of the discharge table marked "Southeasterly portion of the watershed southeast of old dam," etc., refers to the area above the reservoir, which was constructed at an early date. At a later period, at a point lower down the stream, the Crystal Springs dam was constructed and flooded water over the top of the original dam and into the valleys of other streams. This explains the change in the description of the drainage basin which occurs in 1888. The portion of the table marked "Above southeasterly and northeasterly portion of peninsula watershed, total Crystal Lake drainage," is for the entire area above the Crystal Springs gage datum. The remarkable variation in percentage strikingly illustrates the necessity for storing water from the drainage basins in order to provide for periods of drought. In the western portion of the drainage basin there was practically no run-off in the season of 1876–77, and in the easterly portion of the basin there was practically no run-off in the seasons of 1881–82, 1882–83, and 1897–98. It would therefore be necessary to store enough water in the reservoirs to furnish a supply for two summers and at least one winter. Another feature of interest in this table is that while the run-off in the seasons of 1881–82 and 1882–83 was practically nothing from the easterly portion of the basin, the percentage of rainfall in the western portion of the watershed was 29.4 and 23, respectively.

Rainfall and run-off from basin of San Mateo Creek, California.

Year.	Rainfall.	Run-off.
Western portion of peninsula watershed:	*Inches.*	*Per cent.*
1869-70	41.95	22.6
1870-71	34.70	9.8
1871-72	80.42	31.4
1872-73	39.31	28.4
1873-74	48.88	29.5
1874-75	44.26	21.2
1875-76	69.24	39.2
1876-77	23.83	.7
1877-78	72.51	37.8
1878-79	56.10	29.2
1879-80	56.14	35.0
1880-81	53.81	43.0
1881-82	34.23	29.4
1882-83	33.89	23.0
1883-84	54.99	33.2
1884-85	38.25	30.0
1885-86	51.90	43.9
1886-87	34.44	29.1
1887-88	37.53	29.2
1888-89	41.17	28.1
1889-90	73.67	44.7
1890-91	37.69	22.8
1891-92	43.10	13.3
1892-93	58.25	24.4
1893-94	54.90	21.8
1894-95	66.93	25.2
1895-96	49.45	21.0
1896-97	50.47	34.0
1897-98	26.26	9.6
1898-99	42.56	17.7
Total	1,450.83	808.2
Mean	48.36	26.94

Year.	Rainfall.	Run-off.
Southeasterly portion of peninsula watershed (southeast from old dam):	*Inches.*	*Per cent.*
1877-78	57.70	29.3
1878-79	43.12	12.2
1879-80	48.01	15.1
1880-81	38.78	34.1
1881-82	25.02	.9
1882-83	23.06	.0
1883-84	40.32	26.8
1884-85	25.67	13.1
1885-86	35.58	25.4
1886-87	28.61	9.7
1887-88	32.96	5.3
1888-89	35.70	7.4
Total	434.53	179.5
Mean	36.21	14.94
Above southeasterly and northeasterly portions of peninsula watershed, total Crystal Lake drainage:		
1889-90	72.68	53.2
1890-91	31.92	24.4
1891-92	24.16	8.0
1892-93	47.07	34.3
1893-94	33.08	29.0
1894-95	55.77	33.8
1895-96	32.62	16.2
1896-97	35.62	19.3
1897-98	18.17	0.0
1898-99	30.37	11.0
Total	381.46	230.1
Mean	38.15	23.01

SAN ROQUI CREEK.

San Roqui Creek was measured during the year 1890 by Charles J. Johansen for the Pacific Improvement Company. The point of measurement was a short distance below the San Roqui tunnel, which was being built from 1899 to 1901, the point of measurement being near an old dam in the stream. This drainage line is called San Roqui Creek in its mountainous portions, but lower down and south of the Southern Pacific Railroad it is called the Arroyo Burro.

List of discharge measurements of San Roqui Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
Feb. 13	Charles J. Johansen	4.96	At old diversion box below tunnel.
Feb. 19	do	5.70	Do.
Feb. 21	do	9.61	Do.
Feb. 26	do	11.03	Do.
Mar. 1	do	6.91	Do.
Mar. 3	do	6.28	Do.
Mar. 5	do	5.67	Do.
Mar. 6	do	5.67	Do.
Mar. 8	do	5.20	Do.
Mar. 10	do	5.20	Do.
Mar. 12	do	4.96	Do.
Mar. 14	do	4.96	Do.
Mar. 16	do	4.27	Do.
Mar. 18	do	4.27	Do.
Mar. 20	do	4.73	Do.
Mar. 22	do	4.73	Do.
Mar. 24	do	4.27	Do.
Mar. 26	do	3.84	Do.
Mar. 28	do	3.84	Do.
Mar. 30	do	3.84	Do.
Apr. 1	do	3.42	Do.
Apr. 3	do	3.42	Do.
Apr. 5	do	3.42	Do.
Apr. 7	do	3.21	Do.
Apr. 9	do	3.21	Do.
Apr. 11	do	3.00	Do.
Apr. 13	do	2.80	Do.
Apr. 15	do	2.62	Do.
Apr. 17	do	2.62	Do.
Apr. 19	do	2.42	Do.
Apr. 21	do	2.15	Do.
Apr. 23	do	1.88	Do.
Apr. 25	do	1.80	Do.
Apr. 27	do	1.80	Do.
Apr. 29	do	1.55	Do.
May 1	do	1.55	Do.
May 3	do	1.39	Do.
May 5	do	1.39	Do.
May 7	do	1.39	Do.
May 9	do	1.23	Do.
May 11	do	1.23	Do.

List of discharge measurements of San Roqui Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
May 13	Charles J. Johansen	1.30	At old diversion box below tunnel.
May 15	do	1.23	Do.
May 17	do	1.23	Do.
May 19	do	1.23	Do.
May 20	do	.63	Do.
May 22	do	.65	Do.
May 24	do	.65	Do.
May 26	do	.65	Do.
May 28	do	.54	Do.
May 30	do	.54	Do.
June 2	do	.52	Do.
June 4	do	.52	Do.
June 5	do	.44	Do.
June 7	do	.40	Do.
June 9	do	.35	Do.
June 11	do	.35	Do.
June 13	do	.35	Do.
June 15	do	.35	Do.
June 17	do	.38	Do.
June 19	do	.38	Do.
June 21	do	.38	Do.
June 23	do	.38	Do.
June 25	do	.35	Do.
June 27	do	.35	Do.
June 29	do	.29	Do.
July 1	do	.29	Do.
July 3	do	.29	Do.
July 5	do	.29	Do.
July 7	do	.29	Do.
July 9	do	.29	Do.
July 11	do	.26	Do.
July 13	do	.26	Do.
July 15	do	.26	Do.
July 17	do	.26	Do.
July 19	do	.23	Do.
July 21	do	.20	Do.
July 23	do	.20	Do.
July 25	do	.20	Do.
July 27	do	.20	Do.
July 29	do	.20	Do.
July 31	do	.24	Do.

List of discharge measurements of San Roqui Creek, etc.—Continued.

Date.	Hydrographer.	Discharge.	Locality.
1890.		*Sec.-feet.*	
Aug. 2	Charles J. Johansen	0.24	At old diversion box below tunnel.
Aug. 4	do	.24	Do.
Aug. 6	do	.24	Do.
Aug. 8	do	.26	Do.
Aug. 10	do	.26	Do.
Aug. 12	do	.26	Do.
Aug. 14	do	.23	Do.
Aug. 16	do	.23	Do.
Aug. 18	do	.20	Do.
Aug. 19	do	.20	Do.
Aug. 22	do	.17	Do.
Sept. 2	do	.19	Do.
Sept. 3	do	.19	Do.
Sept. 4	do	.19	Do.
Sept. 5	do	.19	Do.
Sept. 6	do	.19	Do.
Sept. 7	do	.19	Do.
Sept. 8	do	.19	Do.
Sept. 10	do	.19	Do.
Sept. 11	do	.19	Do.
Sept. 12	do	.19	Do.
Sept. 13	do	.19	Do.
Sept. 14	do	.19	Do.
Aug. 26	do	.09	Below old diversion box.
Aug. 28	do	.09	Do.
Aug. 30	do	.07	Do.
Sept. 2	do	.04	Do.
Sept. 4	do	.04	Do.
Sept. 6	do	.05	Do.
Sept. 8	do	.04	Do.
Sept. 10	do	.04	Do.
Sept. 12	do	.04	Do.
Sept. 14	do	.04	Do.

SANTA ANA RIVER.

The river has its source on the southwestern slope of the San Bernardino Mountains and flows west, appearing from its canyon 6 miles northeast of Redlands. Its waters are completely used in San Bernardino Valley. At the lower part of the valley the water appears again in the vicinity of Rincon, where the river passes through a

comparatively narrow gorge, and the stream flows thence in a general southwesterly direction, emptying into the Pacific Ocean. The station, established June, 1896, is located 5 miles northeast of Mentone, Cal., three-fourths of a mile below the head works of the Santa Ana canal and opposite the warm springs in the canyon. The gage is an inclined timber fastened to a large bowlder and posts set in the bank of the river. On October 16, 1898, owing to some local legal complications, an unusually large volume of water was turned into the Santa Ana canal by the Bear Valley Company. This water was wasted from the canal at a point below the old gage rod, necessitating the establishment of a new gage rod upon this stream at a point below where the waste from the canal was turned into the river. The new gage was put in November 9, 1898, and since that date daily observations have been kept on the lower gage, which is a 2 by 6 inch timber firmly bolted to a granite cliff, which forms the left bank of the river, and is situated 800 feet below the mouth of Warmsprings Canyon and 100 feet above a ford on the canyon road. A landslide occurred below the gage rod April 16, 1899, which changed the condition of the rating for the station. Owing to the shifting nature of the stream bed it has not been possible to construct perfectly satisfactory rating curves, but the tables as presented are based on the best information that could be obtained. This river is one of the most difficult streams in the State to accurately gage. The Edison Electric Company diverts the greater portion of the water of Santa Ana River above the gaging station, but also returns all of it above the station. Only limited portions of the water are allowed to pass out of the conduits during certain hours of the day, the water being held back for the purpose of obtaining additional power when the greatest demand exists. An effort is being made to arrange with this company to obtain a record of the number of gates, the sizes of the openings, and the hours at which the various wheels are run, in order to more accurately determine the volumes of water. The Santa Ana canal, as mentioned above, also diverts water from Santa Ana River above the station, but the greater part of it is returned to the channel of the stream before passing the point of measurement.

It was found that this station could not be used during high water, and on January 1, 1901, observations were resumed at the old station and on Santa Ana Canal near the river station.

From June 1 to December 31, 1901, and for the entire year 1902, except from February 26 to April 23, inclusive, the discharge of Santa Ana River was obtained by observations on the weirs at the head works of Green Spot pipe line, Highlands canal, and Redlands canal. The flow from Redlands tunnel and Morton Canyon was assumed to offset the loss by evaporation between the old gaging station and the mouth of the canyon.

The drainage area used prior to 1902 was obtained from Land Office maps. Subsequently the Geological Survey completed its contour

map of this basin and an area of 182 square miles above the gaging station was obtained therefrom and was accepted.

Discharge measurements of Alder Creek, a branch of Santa Ana River, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
August 8, 1897	A. Q. Campbell	0.88
August 31, 1897	do	1.00
November 14, 1897	J. B. Lippincott	2.00
April 14, 1900	S. G. Bennett	1.90
October 8, 1901	do	.89

Discharge measurements of Santa Ana River above mouth of Bear Creek, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
July 27, 1896	J. H. Quinton	14.2
August 31, 1897	A. Q. Campbell	17.9
November 14, 1897	J. B. Lippincott	17.5

The discharge of the streams of southern California was unusually low in September, 1898, and these measurements were made to determine this minimum with its hourly fluctuation.

Discharge measurements of Santa Ana River above mouth of Bear Creek.

[Measurements by Edison Electric Company.]

Date.	Discharge.	Date.	Discharge.
Sept. 15, 1898:	*Sec.-feet.*	Sept. 15, 1898—Continued.	*Sec.-feet.*
7 a. m	8.22	1.30 p. m	7.12
7.30 a. m	8.22	2 p. m	7.20
8 a. m	8.22	2.30 p. m	7.06
8.30 a. m	8.22	3 p. m	6.92
9 a. m	8.22	3.30 p. m	6.86
9.30 a. m	8.22	4 p. m	6.66
10 a. m	8.46	4.30 p. m	6.98
10.30 a. m	8.10	5 p. m	6.44
11 a. m	7.98	5.30 p. m	6.22
11.30 a. m	7.86	6 p. m	6.22
12 m	7.76	6.30 p. m	6.10
12.30 p. m	7.48	12-hour mean	7.43
1 p. m	7.54		

Discharge measurements of Santa Ana River, etc.—Continued.

Date.	Discharge.
Sept. 15, 1898—Continued.	*Sec.-feet.*
7 p. m	6.10
7.30 p. m	6.10
8 p. m	6.10
8.30 p. m	6.02
9 p. m	6.02
9.30 p. m	6.02
10 p. m	6.02
10.30 p. m	6.02
11 p. m	6.32
11.30 p. m	6.96
12 midnight	6.60
Sept. 16, 1898:	
12.30 a. m	6.66
1 a. m	6.66
1.30 a. m	6.86
2 a. m	6.92
2.30 a. m	7.06
3 a. m	7.20
3.30 a. m	7.32
4 a. m	7.54
4.30 a. m	7.66
5 a. m	7.66
5.30 a. m	7.86
6 a. m	7.76
6.30 a. m	7.76
12-hour mean	6.80
7 a. m	7.76
7.30 a. m	7.76
8 a. m	8.10
8.30 a. m	7.98
9 a. m	8.04
9.30 a. m	8.10
10 a. m	7.82
10.30 a. m	7.98
11 a. m	7.86
11.30 a. m	7.76
12 m	7.48
12.30 p. m	7.44
1 p. m	7.32

Date.	Discharge.
Sept. 16, 1898—Continued.	*Sec.-feet.*
1.30 p. m	7.32
2 p. m	7.20
2.30 p. m	7.06
3 p. m	6.86
3.30 p. m	6.66
4 p. m	6.44
4.30 p. m	6.32
5 p. m	6.22
5.30 p. m	6.10
6 p. m	6.02
6.30 p. m	6.02
12-hour mean	7.23
7 p. m	6.20
7.30 p. m	6.20
8 p. m	6.20
8.30 p. m	6.20
9 p. m	5.76
9.30 p. m	5.92
10 p. m	5.92
10.30 p. m	6.02
11 p. m	6.22
11.30 p. m	6.32
12 midnight	6.32
Sept. 17, 1898:	
12.30 a. m	6.44
1 a. m	6.66
1.30 a. m	6.76
2 a. m	6.86
2.30 a. m	6.92
3 a. m	7.06
3.30 a. m	7.20
4 a. m	7.32
4.30 a. m	7.32
5 a. m	7.54
5.30 a. m	7.54
6 a. m	7.66
6.30 a. m	7.76
12-hour mean	6.68

Discharge measurements of Bear Creek above Santa Ana River, San Bernardino County.

[Measurements by Edison Electric Co.]

Date.	Discharge.	Date.	Discharge.
Sept. 15, 1898:	*Sec.-feet.*	Sept. 16, 1898:	*Sec.-feet.*
7 a. m	23.30	12.30 a. m	19.74
7.30 a. m	23.30	1 a. m	19.74
8 a. m	23.30	1.30 a. m	19.54
8.30 a. m	25.94	2 a. m	19.34
9 a. m	23.30	2.30 a. m	19.14
9.30 a. m	23.30	3 a. m	18.72
10 a. m	23.30	3.30 a. m	18.72
10.30 a. m	23.10	4 a. m	18.32
11 a. m	23.10	4.30 a. m	18.32
11.30 a. m	22.84	5 a. m	18.12
12 m	22.66	5.30 a. m	18.12
12.30 p. m	22.66	6 a. m	17.92
1 p. m	22.66	6.30 a. m	17.80
1.30 p. m	22.66	12-hour mean	19.84
2 p. m	22.66		
2.30 p. m	22.66	7 a. m	17.92
3 p. m	22.66	7.30 a. m	17.92
3.30 p. m	22.44	8 a. m	17.80
4 p. m	22.44	8.30 a. m	16.94
4.30 p. m	22.44	9 a. m	17.34
5 p. m	22.02	9.30 a. m	17.24
5.30 p. m	22.02	10 a. m	17.12
6 p. m	22.02	10.30 a. m	17.12
6.30 p. m	21.80	11 a. m	16.84
12-hour mean	22.86	11.30 a. m	16.94
		12 m	16.56
7 p. m	21.60	12.30 p. m	16.94
7.30 p. m	21.60	1 p. m	16.76
8 p. m	21.60	1.30 p. m	16.76
8.30 p. m	21.40	2 p. m	16.56
9 p. m	21.06	2.30 p. m	16.56
9.30 p. m	21.18	3 p. m	16.56
10 p. m	20.98	3.30 p. m	16.56
10.30 p. m	20.98	4 p. m	16.38
11 p. m	20.78	4.30 p. m	16.38
11.30 p. m	21.60	5 p. m	16.38
12 midnight	19.94	5.30 p. m	16.38

Discharge measurements of Bear Creek, etc.—Continued.

Date	Discharge.	Date.	Discharge.
Sept. 16, 1898—Continued.	*Sec.-feet.*	Sept. 17, 1898:	*Sec.-feet.*
6 p. m	16.38	12.30 a. m	16.38
6.30 p. m	16.38	1 a. m	16.38
12-hour mean	16.86	1.30 a. m	16.38
		2 a. m	16.38
7 p. m	16.38	2.30 a. m	16.38
7.30 p. m	16.28	3 a. m	16.38
8 p. m	16.28	3.30 a. m	16.38
8.30 p. m	16.28	4 a. m	16.38
9 p. m	16.18	4.30 a. m	16.38
9.30 p. m	16.38	5 a. m	16.38
10 p. m	16.38	5.30 a. m	16.38
10.30 p. m	16.38	6 a. m	16.38
11 p. m	16.38	6.30 a. m	16.38
11.30 p. m	16.38	12-hour mean	16.36
12 midnight	16.38		

Discharge measurements of Bear Creek above Santa Ana River, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
July 27, 1896	J. H. Quinton	70.6
Aug. 31, 1897	A. Q. Campbell	54.3
Nov. 14, 1897	J. B. Lippincott	8.95

Discharge measurements of Green Spot Pipe Line, Santa Ana River, San Bernardino County.

Date.	Hydrographer.	Discharge.
1896.		*Sec.-feet.*
Nov. 21	J. B. Lippincott	0.40
1898.		
Jan. 8	J. B. Lippincott	.38
Apr. 12	do	[a] 1.88
Apr. 12	do	[b] 1.74
Apr. 29	do	2.94
June 12	do	.63
July 23	do	2.20
Sept. 8	do	0.00
Oct. 18	F. H. Olmsted	1.36
Nov. 9	do	.50
Dec. 8	do	.50
Dec. 8	do	[b] .15

[a] Intake. [b] Outlet (lower end).

Discharge measurements of Green Spot Pipe Line, etc.—Continued.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
Jan. 12	S. G. Bennett	0.00
Feb. 18	do	[a] 3.53
Feb. 18	do	[b] .35
Mar. 23	do	3.71
May 6	do	[a] 1.43
May 6	do	[b] .62
May 31	do	.14
July 15	do	[a] .59
July 15	do	[b] .44
July 27	do	[a] .64
July 27	do	[b] .54
Aug. 24	do	[b] .28
1900.		
April 14	S. G. Bennett	2.15
July 13	do	[a] 0.00
Oct. 2	W. W. Cockins, jr	[a] .12
1901.		
Feb. 5	S. G. Bennett	[a] 0.00
Mar. 4	do	[a] 2.73
Mar. 30	do	[a] 0.00
July 6	do	[a] 3.68
July 6	do	[b] 3.49
Aug. 20	do	0.00
Oct. 8	do	5.77
Dec. 5	do	1.65
1902.		
May 31	S. G. Bennett	[a] 2.70
May 31	do	[b] 2.50
July 10	do	[a] 0.00
Sept. 3	W. W. Clapp	[a] 0.00
Nov. 5	S. G. Bennett	[a] 2.83

[a] Intake. [b] Outlet (lower end)

Estimated monthly discharge of Bear Valley Water, Green Spot Pipe Line, Santa Ana River, at head of Crafton ditch, San Bernardino County.

Month.	Mean discharge.	Month.	Mean discharge.
1897.	*Sec.-feet.*	1899.	*Sec.-feet.*
August	21.5	July	5.8
September	15.8	August	5.8
October 1 to 21	13.2	September	4.1
1898.		October	6.6
April	17.0	November	8.6
May	17.2	December	9.5
June	13.2	1900.	
July	9.1	January	2.1
August	9.1	February	2.5
September	8.2	March	1.5
October	9.0	April	2.3
November	10.0	May	1.9
December	10.7	June	.4
1899.		July 1 to 15	1.1
January 1 to 9	11.0	August	0
February	11.6	September	0
March	12.2	October	0
April	11.8	November	0
May	11.2	December	0
June	5.4		

Estimated monthly discharge of Green Spot Pipe Line, Santa Ana River, at Headworks Weir, San Bernardino County.

Month.	Mean discharge.	Month.	Mean discharge.
1901.	*Sec.-feet.*	1901—Continued.	*Sec.-feet.*
June	1.5	October	5.7
July	2.3	November	1.7
August	2.7	December	1.2
September	5.5		

Discharge measurements of Highlands or North Fork Canal at intake weir, Santa Ana River, San Bernardino County.

Date.	Hydrographer.	Discharge.
1896.		*Sec.-feet.*
Nov. 21	J. B. Lippincott	8.50
1898.		
Jan. 8	J. B. Lippincott	11.91
Mar. 9	H. Crowe	10.76
Apr. 12	J. B. Lippincott	12.40
Apr. 29	do	17.03
June 12	do	11.37
Sept. 8	do	13.29
Oct. 18	F. H. Olmsted	9.85
Nov. 9	do	8.12
Dec. 8	do	6.95
1899.		
Feb. 18	S. G. Bennett	8.07
Mar. 23	do	11.78
May 6	do	7.70
May 31	do	6.74
June 15	do	10.30
July 15	do	13.14
July 27	do	11.92
Aug. 24	do	4.28
1900.		
Apr. 14	S. G. Bennett	7.48
July 13	do	([a])
Oct. 2	W. W. Cockins, jr	5.61
1901.		
July 6	S. G. Bennett	13.28
Aug. 20	do	15.79
Oct. 8	do	14.30
Dec. 5	do	8.53
May 31	do	7.90
1902.		
July 10	S. G. Bennett	11.50
Sept. 3	W. B. Clapp	11.10
Nov. 5	S. G. Bennett	10.02

[a] Water not going through weir basin; weir was being repaired.

Discharge measurements of Santa Ana River above Keller Creek, San Bernardino County.[a]

[Measurements by Edison Electric Company.]

Date.	Discharge.	Date.	Discharge.
Sept. 15, 1898:	*Sec.-feet.*	Sept. 16, 1898:	*Sec.-feet.*
7 a. m	29.30	12.30 a. m	27.08
7.30 a. m	30.44	1 a. m	27.08
8 a. m	23.30	1.30 a. m	27.08
8.30 a. m	30.44	2 a. m	27.08
9 a. m	30.44	2.30 a. m	26.02
9.30 a. m	30.44	3 a. m	26.02
10 a. m	30.44	3.30 a. m	26.02
10.30 a. m	30.44	4 a. m	26.02
11 a. m	30.44	4.30 a. m	26.02
11.30 a. m	30.44	5 a. m	24.92
12 m	29.30	5.30 a. m	24.92
12.30 p. m	29.30	6 a. m	24.92
1 p. m	29.30	6.30 a. m	24.92
1.30 p. m	29.30	12-hour mean	27.06
2 p. m	29.30		
2.30 p. m	29.30	7 a. m	24.92
3 p. m	29.30	7.30 a. m	24.92
3.30 p. m	28.20	8 a. m	24.92
4 p. m	28.20	8.30 a. m	24.92
4.30 p. m	28.20	9 a. m	24.92
5 p. m	28.20	9.30 a. m	24.92
5.30 p. m	28.20	10 a. m	24.92
6 p. m	28.20	10.30 a. m	24.92
6.30 p. m	29.30	11 a. m	24.92
12-hour mean	29.16	11.30 a. m	24.92
		12 m	24.92
7 p. m	29.30	12.30 p. m	23.86
7.30 p. m	28.22	1 p. m	23.86
8 p. m	28.20	1.30 p. m	23.86
8.30 p. m	28.20	2 p. m	22.80
9 p. m	28.20	2.30 p. m	22.80
9.30 p. m	28.20	3 p. m	22.80
10 p. m	28.20	3.30 p. m	22.80
10.30 p. m	28.20	4 p. m	22.80
11 p. m	28.20	4.30 p. m	21.80
11.30 p. m	28.20	5 p. m	21.80
12 midnight	28.20	5.30 p. m	21.80

[a] The discharge of the streams of southern California was unusually low in September, 1898, and these measurements were made by the Edison Electric Company to determine this minimum with its hourly fluctuation.

Discharge measurements of Santa Ana River, etc.—Continued.

Date.	Discharge.	Date.	Discharge.
Sept. 16, 1898—Continued.	*Sec.-feet.*	Sept. 17, 1898:	*Sec.-feet.*
6 p. m.	21.80	12.30 a. m.	22.80
6.30 p. m.	22.80	1 a. m.	22.80
12-hour mean	23.74	1.30 a. m.	23.86
		2 a. m.	23.86
7 p. m.	22.80	2.30 a. m.	23.86
7.30 p. m.	22.80	3 a. m.	23.86
8 p. m.	22.80	3.30 a. m.	23.86
8.30 p. m.	23.86	4 a. m.	23.86
9 p. m.	23.86	4.30 a. m.	23.86
9.30 p. m.	22.80	5 a. m.	23.86
10 p. m.	22.80	5.30 a. m.	22.80
10.30 p. m.	22.80	6 a. m.	21.80
11 p. m.	22.80	6.30 a. m.	22.80
11.30 p. m.	22.80	12-hour mean	23.20
12 midnight	22.80		

Discharge measurements of Keller Creek, a tributary of Santa Ana River.

Date.	Hydrographer.	Discharge.
1897.		*Sec.-feet.*
Nov. 14	A. Q. Campbell	1.00
1900.		
Apr. 14	S. G. Bennett	.67

Discharge measurements of Morton Canyon Water, tributary to Santa Ana River.

Date.	Hydrographer.	Discharge.
1898.		*Sec. feet.*
Apr. 12	J. B. Lippincott	0.20
Apr. 29	do	.20
June 12	do	.12
1899.		
May 31	S. G. Bennett	.23
June 15	do	.17
July 15	do	.12
Aug. 24	do	.11
1900.		
Apr. 14	S. G. Bennett	.29
July 13	do	.09
Oct. 2	W. W. Cockins, jr	.12

Discharge measurements of Redlands or South Fork canal weir at Sand Box, tributary to Santa Ana River.

Date.	Hydrographer	Discharge.
1896.		*Sec.-feet.*
July 29	J. H. Quinton	40.62
Nov. 21	J. B. Lippincott	12.00
1898.		
Jan. 8	J. B. Lippincott	21.32
Mar. 9	H. Crowe	22.22
Apr. 12	J. B. Lippincott	16.70
Apr. 29	do	13.00
June 12	do	18.40
July 23	do	15.00
Sept. 8	do	15.40
Oct. 18	F. H. Olmsted	7.26
Nov. 9	do	10.20
Dec. 8	do	12.00
1899.		
Jan. 12	S. G. Bennett	15.10
Feb. 18	do	15.70
Mar. 23	do	17.00
May 6	do	15.49
May 31	do	14.67
June 15	do	7.76
June 27	do	12.40
July 15	do	12.70
Aug. 24	do	5.71

Discharge measurements of Redlands or South Fork canal weir, etc.—Cont'd.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
Apr. 14	S. G. Bennett	12.10
July 13	do	10.65
Oct. 2	W. W. Cockins, jr	6.25
1901.		
Mar. 30	S. G. Bennett	30.00
May 31	do	19.60
July 6	do	19.91
Aug. 20	do	16.75
Oct. 8	do	24.10
Dec. 5	do	14.27
1902.		
July 10	S. G. Bennett	10.06
Sept. 3	W. B. Clapp	14.60
Nov. 5	S. G. Bennett	7.55

Discharge measurements of Redlands or Bolen tunnel, tributary to Santa Ana River.

Date.	Hydrographer.	Discharge.
1896.		*Sec.-feet.*
Nov. 21.	J. B. Lippincott	1.00
1898.		
June 12	J. B. Lippincott	1.24
Sept. 8	do	1.24
1899.		
June 15	S. G. Bennett	.67
July 15	do	1.03
Aug. 24	do	1.10
1900.		
Apr. 14	S. G. Bennett	.88
July 13	do	.84
Oct. 2	W. W. Cockins, jr	.85
1901.		
July 6	S. G. Bennett	1.40
Dec. 5	do	.90
1902.		
July 10	do	.90

Discharge measurements of Santa Ana Canal, San Bernardino County.[a]

Date.	Hydrographer.	Discharge.
1896.		*Sec.-feet.*
June 20	J. B. Lippincott	18.28
July 28	J. H. Quinton	14.98
Nov. 21	J. B. Lippincott	3.50
1897.		
Jan. 27	J. B. Lippincott	4.00
Mar. 4	do	5.00
June 15	do	19.00
July 1	do	18.50
July 6	A. Q. Campbell	12.42
July 6	do	11.02
Aug. 8	do	18.68
Aug. 31	do	18.49
Sept. 30	do	22.95
Nov. 14	do	7.29
1898.		
Jan. 8	A. Q. Campbell	8.72
Mar. 9	do	7.04
Apr. 2	J. B. Lippincott	12.66
Apr. 12	do	7.67
June 12	do	3.92
July 23	do	5.34
Sept. 8	do	1.66
Oct. 18	F. H. Olmsted	7.92
Nov. 9	do	19.50
Dec. 8	do	20.60
1899.		
Jan. 12	S. G. Bennett	.00
Feb. 18	do	4.00
Mar. 23	do	7.60
May 6	do	3.40
May 31	do	1.10
June 15	do	.20
July 15	do	.00
July 27	do	.00
Aug. 24	do	.00

[a] For total flow of river and canal see Santa Ana River, total flow.

Discharge measurements of Santa Ana Canal, etc.—Continued.

Date.	Hydrographer.	Discharge.
1901.		*Sec.-feet.*
Mar. 30	S. G. Bennett	3.40
Oct. 8	do	13.20
Dec. 5	do	9.70
1902.		
May 31	S. G. Bennett	20.70
July 10	do	18.5
Sept. 3	W. B. Clapp	14.2
Nov. 5	S. G. Bennett	12.7

Discharge measurements of Santa Ana River and Canal at Warm Spring, San Bernardino County.

Date.	Hydrographer.	Gage height.	Discharge.
1896.		*Feet.*	*Sec.-feet.*
Apr. 27	J. A. Vogleson		51.00
July 25	J. H. Quinton		75.00
June 20	J. B. Lippincott		[a]61.77
Do	do		[b]18.28
	Total		80.05
1896.			
July 28	J. H. Quinton	1.29	[a]59.72
Do	do		[b]14.98
	Total		74.70
Nov. 21	J. B. Lippincott	.98	[a]31.68
Do	do		[b]3.50
	Total		35.18
Nov. 21	J. B. Lippincott		[c]27.40
1897.			
Jan. 27	J. B. Lippincott		[a]43.58
Do	do		[b]4.00
	Total		47.58
Mar. 4	J. B. Lippincott		[a]100.70
Do	do		[b]5.00
	Total		105.70

[a] River. [b] Santa Ana Canal. [c] Total flow at mouth of canyon.

Discharge measurements of Santa Ana River and Canal, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1897.		*Feet.*	*Sec.-feet.*
June 15	J. B. Lippincott	1.15	[a] 63.74
Do	do		[b] 19.00
	Total		82.74
July 1	A. Q. Campbell	1.20	[a] 72.29
Do	do		[b] 18.50
	Total		90.79
July 6	A. Q. Campbell	1.1	[a] 60.35
Do	do		[b] 11.02
	Total		71.37
Aug. 8	A. Q. Campbell	1.32	[a] 56.28
Do	do		[b] 18.68
	Total		74.96
Aug. 8	A. Q. Campbell		[c] 83.22
Aug. 31	do		[d] 78.10
Do	do		[c] 78.37
Sept. 30	do		64.53
Do	do	1.13	[a] 42.53
Do	do		[b] 22.95
	Total		65.48
Nov. 14	A. Q. Campbell	1.25	[a] 39.92
Do	do		[b] 7.29
	Total		47.21
1898.			
Jan. 8	J. B. Lippincott	1.00	[a] 25.56
Do	do		[b] 8.72
	Total		34.28
Mar. 9	H. Crowe	1.05	[a] 43.78
Do	do		[b] 7.04
	Total		50.82

[a] River.
[b] Santa Ana Canal.
[c] Weir above Santa Ana Canal intake.
[d] Meter above Santa Ana Canal intake.

Discharge measurements of Santa Ana River and Canal, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1898.		*Feet.*	*Sec.-feet.*
Mar. 9	H. Crowe		[a] 68.01
Apr. 11	J. B. Lippincott	.98	[b] 31.61
Do	do		[c] 7.67
	Total		39.28
Apr. 29	J. B. Lippincott	.90	[b] 29.67
Do	do		[c] 12.66
	Total		42.33
June 12	J. B. Lippincott	1.10	[b] 35.14
Do	do		[c] 3.92
	Total		39.06
July 23	J. B. Lippincott	1.10	[b] 42.22
Do	do		[c] 5.34
	Total		47.56
Sept. 8	J. B. Lippincott	1.05	[b] 35.01
Do	do		[c] 1.66
	Total		36.67
Oct. 18	F. H. Olmsted	.95	[b] 22.78
Do	do		[c] 7.92
	Total		30.70
Nov. 9	F. H. Olmsted	1.10	[d] 21.78
Dec. 8	do	1.13	[d] 24.74
1899.			
Jan. 12	S. G. Bennett	1.07	[b] 38.00
Do	do		[c] 0
	Total		38.00
Feb. 18	S. G. Bennett	[e] 2.16	[b] 28.04
Do	do		[c] 4.00
	Total		32.04
Mar. 23	S. G. Bennett	2.30	[b] 29.62
Do	do		[c] 7.60
	Total		37.22

[a] Above Santa Ana Canal intake.
[b] River.
[c] Canal.
[d] Total water from Santa Ana Canal wasted above gaging station.
[e] New rod.

Discharge measurements of Santa Ana River and Canal, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1899.		*Feet.*	*Sec.-feet.*
May 6	S. G. Bennett	2.45	[a] 25.84
Do	do		[b] 3.40
	Total		29.24
May 31	S. G. Bennett	2.27	[a] 21.00
Do	do		[b] 1.10
	Total		22.10
June 15	S. G. Bennett	2.21	[a] 19.60
Do	do		[b] .20
	Total		19.80
July 15	S. G. Bennett	2.30	[a] 25.90
Do	do		[b] 0
July 27	do	2.3	[a] 23.55
Do	do		[b] 0
Aug. 24	do	1.85	[a] 10.86
Do	do		[b] 0
1900.			
Apr. 14	S. G. Bennett	2.25	[a] 22.66
Do	do		[b] 0
July 13	S. G. Bennett		[a] 22.30
Do	do		[b] 0.0
Nov. 20	do	[c] 1.70	[a] 102.00
Do	do		[b] 0.0
1901.			
Feb. 5	S. G. Bennett	1.65	[d] 101.00
Feb. 23	do	1.80	[d] 110.00
Mar. 4	do	1.70	[d] 102.00
Mar. 30	do	1.35	[a] 40.60
Do	do		[b] 3.40
	Total		44.00
July 6	S. G. Bennett	1.15	[a] 26.10
Do	do		[b] 13.20
	Total		39.30
Do	S. G. Bennett		[e] 36.90
			[f] 1.40
	Total		35.50
			[g] 3.80
Aug. 20	S. G. Bennett	1.24	[a] 30.78
Do	do		[b] 0.0

[a] River.
[b] Canal.
[c] Old rod.
[d] Total flow.
[e] Total for canals at mouth of canyon, including tunnel water.
[f] Less tunnel water.
[g] Loss from Warm Spring to mouth of canyon.

Discharge measurements of Santa Ana River and Canal, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec-feet.*
Oct. 8	S. G. Bennett	1.25	[a] 32.00
Do	do		[b] 13.20
	Total		45.20
Dec. 5	S. G. Bennett	1.03	[a] 14.00
Do	do		[b] 9.70
	Total		23.70
1902.			
Apr. 5	S. G. Bennett	1.39	[a] 51.00
Do	do		[b] 4.20
	Total		55.20
May 31	S. G. Bennett	.91	[a] 8.30
Do	do		[b] 20.70
	Total		29.00
July 10	S. G. Bennett	.84	[a] 5.00
Do	do		[b] 18.50
	Total		23.50
Sept. 3	W. B. Clapp	.95	[a] 10.00
Do	do		[b] 14.20
	Total		24.20
Nov. 5	S. G. Bennett	.87	[a] 5.30
Do	do		[b] 12.70
	Total		18.00

[a] River. [b] Canal.

Discharge measurements of Santa Ana River at Warm Spring, San Bernardino County.

Date.	Hydrographer.	Gage height.	Discharge.
1896.		*Feet.*	*Sec.-feet.*
June 20	J. B. Lippincott		61.77
July 28	J. H. Quinton		59.72
Nov. 21	J. B. Lippincott		31.68
1897.			
Jan. 27	J. B. Lippincott		43.58
Mar. 4	do		100.70
June 15	do	1.15	63.74
July 1	A. Q. Campbell	1.20	72.29
July 6	do	1.11	60.35
Aug. 8	do	1.32	56.28
Sept. 30	do	1.13	42.53
Nov. 14	do	1.25	39.92
1898.			
Jan. 8	A. Q. Campbell	1.00	25.56
Mar. 9	H. Crowe	1.05	43.78
Apr. 11	J. B. Lippincott	.98	31.61
Apr. 29	do	.90	29.69
June 12	do	1.10	35.14
July 23	do	1.10	42.22
Sept. 8	do	1.05	35.01
Oct. 18	F. H. Olmsted	.95	22.78
Nov. 9	do	1.10	21.78
Dec. 8	do	1.13	24.74
1899.			
Jan. 12	S. G. Bennett	1.07	38.00
Feb. 18	do	[a]2.16	28.04
Mar. 23	do	2.30	29.62
May 6	do	2.45	25.84
May 31	do	2.27	21.00
June 15	do	2.21	19.60
July 15	do	2.30	25.90
July 27	do	2.30	23.55
Aug. 24	do	1.85	10.86
1900.			
Apr. 11	S. G. Bennett	2.25	22.66
May 5	do	2.20	24.40
July 13	do		22.34
Nov. 20	do	[b]1.70	102.40
Nov. 22	do		[c]15.64

[a] New rod. [b] Old rod. [c] Calculated.

Discharge measurements of Santa Ana River at Warm Spring, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Mar. 4	S. G. Bennett	1.70	102.20
Mar. 30	do	1.35	40.60
Feb. 5	do	1.65	101.00
Feb. 23	do	1.80	110.00
July 6	do	1.15	26.11
Aug. 20	do	1.24	30.78
Oct. 8	do	1.25	32.00
Dec. 5	S. G. Bennett	1.03	14.0
1902.			
May 31	S. G. Bennett	.91	8.3
July 10	do	.84	5.0
Sept. 3	W. B. Clapp	.95	10.0
Nov. 5	S. G. Bennett	.87	5.3

Discharge measurements of Santa Ana River, Alsetrez ditch, in vicinity of Colton and Riverside, San Bernardino and Riverside counties.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
Oct. 25	K. Sanborn	1.53
1902.		
Sept. 29	K. Sanborn	1.96

Discharge measurements of Evans lower ditch, Riverside County.

Date.	Hydrographer.	Discharge.
1898.		*Sec.-feet.*
June 19	F. H. Olmsted	5.68
Aug. 28	do	4.87
1899.		
Aug. 30	S. G. Bennett	4.48
1900.		
July 27	S. G. Bennett	5.27
Oct. 25	K. Sanborn	4.36
1902.		
Sept. 29	K. Sanborn	5.35

Discharge measurements of Evans upper ditch, Riverside County.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
July 27	S. G. Bennett	1.04
Oct. 25	K. Sanborn	3.32
1901.		
Aug. 30	J. B. Lippincott	1.88
1902.		
Sept. 29	K. Sanborn	[a] 2.17
Sept. 29	do	[b] .53

[a] At north line Riverside County. [b] One mile south of north line Riverside County.

Estimated monthly discharge of Santa Ana River at Warm Spring, San Bernardino County, exclusive of Santa Ana canal.

[Drainage area, 188 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Second-feet.*	*Second-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
July	76	48	63	3,891	0.34	0.39
August	83	33	57	3,492	.30	.35
September	77	27	55	3,289	.29	.32
October	170	38	55	3,387	.29	.33
November	52	30	[a] 33	1,939	.17	.19
December	40	33	[a] 35	2,176	.19	.22
1897.						
January	101	27	62	3,836	0.33	0.38
February	580	72	181	10,060	.96	1.00
March	460	64	119	7,317	.63	.72
April	186	101	146	8,675	.78	.87
May	101	29	61	3,769	.33	.38
June	67	57	63	3,737	.33	.37
July	85	57	67	4,119	.36	.41
August	80	34	57	3,505	.30	.35
September	61	38	47	2,779	.25	.28
October	250	25	42	2,582	.22	.25
November	52	34	[a] 38	2,261	.20	.22
December	30	22	[a] 26	1,610	.14	.16
The year	580	22	76	54,250	.40	5.39

[a] The reduced flow of November and December is due to closing the Bear Valley dam.

Estimated monthly discharge of Santa Ana River at Warm Spring, San Bernardino County, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1898.	*Second-feet.*	*Second-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	58	33	40	2,460	0.21	0.24
February	76	33	40	2,221	.21	.22
March	40	25	32	1,968	.17	.20
April	34	28	31	1,845	.16	.18
May	149	26	55	3,382	.29	.33
June	58	36	44	2,618	.23	.26
July	53	33	41	2,521	.22	.25
August	58	33	41	2,521	.22	.25
September	45	28	36	2,142	.19	.21
October	36	19	26	1,599	.14	.16
November	34	18	22	1,309	.12	.13
December	28	22	22	1,353	.12	.14
The year	149	18	36	25,939	.19	2.57
1901.						
January	600	31	78	4,796	0.41	0.47
February	540	48	194	10,774	1.03	1.07
March	114	45	68	4,181	.36	.41
April	107	39	43	2,559	.23	.26
May	68	35	42	2,582	.22	.25
June	44	30	37	2,202	.20	.22
July	42	34	38	2,337	.20	.23
August	200	31	50	3,074	.27	.31
September	60	42	49	2,916	.26	.29
October	96	24	48	2,951	.26	.30
November	36	22	26	1,547	.14	.16
December	25	21	24	1,476	.13	.15
The year	600	21	58	41,395	.31	4.12

Estimated monthly discharge of Santa Ana canal at Warm Spring, San Bernardino County.

[Drainage area, 188 square miles.]

Month	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
July			14	861	0.07	0.08
August			14	861	.07	.08
September			14	833	.07	.08
October			16	984	.09	.10
November			3.5	2,083	.02	.02
December			4.2	2,582	.02	.02
1897.						
January	8.5	3.2	5.6	344	0.03	0.03
February	6	0	4	222	.02	.02
March	6	.5	5.2	320	.03	.03
April	12	0	3.8	226	.02	.02
May	20	0	15	922	.08	.09
June	19	0	16.6	988	.09	.10
July	18.5	10.6	15.6	960	.08	.09
August	20	17.4	18.3	1,125	.10	.12
September			20	1,190	.11	.12
October			12.4	762	.07	.08
November			7	417	.04	.04
December			7	430	.04	.04
The year			10.9	7,906	.06	.78
1898.						
January			9	553	0.05	0.06
February			8	444	.04	.04
March			8	492	.04	.04
April			8	476	.04	.04
May			6	369	.03	.03
June			4	258	.02	.02
July			2	123	.01	.01
August			2	123	.01	.01
September			2	119	.01	.01
October			0	0	0	0
November			0	0	0	0
December			0	0	0	0
The year			4	2,937	.02	.26
1901.						
March	6	0	2.71	167	0.01	0.01
April	4.62	0	2.34	139	.01	.01
May	4.62	3.8	3.96	243	.01	.01

Estimated monthly discharge of Santa Ana River and canals at Warm Spring, San Bernardino County.[a]

[Drainage area, 188 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet*	*Sec.-feet.*	*Inches.*
July			77	4,753	0.41	0.47
August			71	4,353	.38	.44
September			69	4,124	.37	.41
October			71	4,372	.38	.44
November			37	2,148	.19	.21
December			39	2,435	.21	.24
1897.						
January	104	35	68	4,179	0.36	0.41
February	585	77	185	10,282	.98	1.02
March	465	70	124	7,637	.66	.76
April	190	113	150	8,899	.80	.89
May	113	48	76	4,690	.41	.47
June	86	60	80	4,723	.42	.47
July	102	70	83	5,077	.44	.51
August	100	54	75	4,628	.40	.46
September	81	58	67	3,968	.35	.39
October	270	45	54	3,347	.29	.33
November	59	40	45	2,678	.24	.27
December	38	29	33	2,040	.18	.21
The year	585	29	87	62,148	.46	6.19
1898.						
January			49	2,987	0.26	0.30
February			48	2,688	.26	.27
March			40	2,448	.21	.24
April			39	2,333	.21	.23
May			61	3,727	.32	.37
June			48	2,840	.25	.28
July			43	2,625	.23	.26
August			43	2,653	.23	.26
September			38	2,223	.20	.22
October			26	1,581	.14	.16
November			22	1,285	.12	.13
December			22	1,364	.12	.14
The year			40	28,754	.21	2.86

[a] Total flow.

Estimated monthly discharge of Santa Ana River and canals at Warm Spring, San Bernardino County—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	34	22	26	1,593	0.14	0.16
February	34	27	27	1,516	.15	.15
March	48	24	32	1,949	.17	.19
April	34	22	25	1,458	.13	.15
May	27	19	22	1,365	.12	.14
June	34	19	22	1,315	.12	.13
July	29	19	22	1,371	.12	.14
August	19	11	13	782	.07	.08
September	12	10	12	690	.06	.07
October	19	12	17	1,015	.09	.10
November	49	17	21	1,268	.11	.13
December	36	18	23	1,427	.12	.14
The year	49	10	22	15,749	.12	1.58
1900.						
January	36	19	23	1,414	0.12	0.14
February	23	20	22	1,222	.12	.12
March	28	20	23	1,414	.12	.14
April	43	19	25	1,488	.13	.14
May	250	20	57	3,505	.30	.35
June	25	19	22	1,309	.12	.13
July	25	11	19	1,168	.10	.12
August	12	9	11	676	.06	.07
September	16	11	12	714	.06	.07
October	16	12	14	861	.07	.08
November	1,564	14	107	6,367	.57	.63
December	31	25	28	1,722	.15	.17
The year	1,564	9	30	21,860	.16	2.16

Estimated monthly discharge of Santa Ana River and canals at Warm Spring, San Bernardino County—Continued.

Month.	Discharge			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	600	31	78	4,796	0.41	0.47
February	540	48	194	10,774	1.03	1.07
March	114	45	68	4,181	.36	.41
April	107	39	43	2,559	.23	.26
May	68	35	42	2,582	.22	.25
June	44	30	37	2,202	.20	.22
July	42	34	38	2,337	.20	.23
August	200	31	50	3,074	.27	.31
September	60	42	49	2,916	.26	.29
October	96	24	48	2,951	.26	.30
November	36	22	26	1,547	.14	.16
December	25	21	24	1,476	.13	.15
The year	600	21	58	41,395	.31	4.12
1902.						
January	45	20	24	1,476	0.13	0.15
February	240	20	38	2,110	.21	.22
March	485	41	79	4,858	.43	.50
April	71	43	51	3,035	.28	.31
May	45	31	36	2,214	.20	.23
June	47	23	33	1,964	.18	.20
July	32	23	26	1,599	.14	.16
August	30	22	25	1,537	.14	.16
September	29	22	24	1,428	.13	.15
October	55	30	40	2,460	.22	.25
November	43	19	24	1,428	.13	.15
December	27	19	22	1,353	.12	.14
The year	485	19	35	25,462	.19	2.62

Discharge measurements of Santa Ana River at head of Gage canal.[a]

Date.	Hydrographer.	Discharge.
		Sec-feet.
1888.[b]	W. Irwin	2,000.00
1898.		
June 29	J. B. Lippincott	1.16
June 30	do	27.42
Sept. 21	do	25 66

[a] See San Bernardino Valley, Gage canal.
[b] Flood. Since that time floods as great as 4,000 second-feet have been observed.

Discharge measurements of Jurupa Canal.

Date.	Hydrographer.	Discharge.
1898.		*Sec-feet.*
June 18	F. H. Olmsted	13.83
July 1	J. B. Lippincott and K. Sanborn	7.11
Aug. 27	F. H. Olmsted	10.18
Sept. 22	J. B. Lippincott	5.41
May 31	S. G. Bennett	6.74
July 15	do	13.14
1899.		
Aug. 24	S. G. Bennett	[a] 4.28
July 26	do	[a] 5.11
1900.		
July 27	G. S. Bennett	14.42
Oct. 19	K. Sanborn	14.05

[a] Submerged flume above Colton bridge.

Discharge measurement of Santa Ana River below Jurupa ditch.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
June 17, 1898	F. H. Olmsted	9.74

Discharge measurements of Santa Ana River below Roubidoux, Evans Upper, and Trujillo ditches.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
July 27, 1900	S. G. Bennett	0.44
Oct. 25, 1900	K. Sanborn	.56

Discharge measurements of Santa Ana River in vicinity of Colton and Riverside, San Bernardino and Riverside Counties.

RIVERSIDE WATER COMPANY'S LOWER CANAL.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
June —, 1898	K. Sanborn	10.27
Sept. —, 1898	do	7.70
Mar. —, 1899	do	16.20
June —, 1899	do	9.09
Aug. —, 1899	do	7.38
Mar. —, 1900	do	8.00
June —, 1900	K. Sanborn	7.16
Sept. —, 1900	do	6.69
June 17, 1898	F. H. Olmsted	9.27
June 18, 1898	do	11.27
		[a] 10.27
July 27, 1900	S. G. Bennett	7.13
Aug. 30, 1901	J. B. Lippincott	[b] 4.52
Sept. 30, 1902	K. Sanborn	3.07

RIVERSIDE WATER COMPANY'S UPPER CANAL.[c]

Aug. 30, 1899	S. G. Bennett	[d] 57.4
July 26, 1900	do	[d] 43.3

ROUBIDOUX DITCH.

June 19, 1898	F. H. Olmsted	8.94
Aug. 28, 1898	do	8.50
July 27, 1900	S. G. Bennett	8.18
Oct. 25, 1900	K. Sanborn	7.80
Aug. 30, 1901	J. B. Lippincott	8.75
Sept. 30, 1902	K. Sanborn	7.19

SANTA ANA RIVER 1½ MILES BELOW INTAKE OF RIVERSIDE WATER COMPANY'S LOWER CANAL.

Aug. 27, 1898	F. H. Olmsted	0.50

[a] Mean for June 17 and 18.

[b] One-fourth of a mile below headworks; 0.4 second-feet wasted below point of measurement into river for Roubidoux Canal.

[c] See also Riverside Water Company's upper canal, under San Bernardino Valley.

[d] In flume above tunnel near Riverside Mesa.

Discharge measurements of Santa Ana River in vicinity of Colton and Riverside, etc.—Continued.

SPRING BROOK BELOW WEST RIVERSIDE BRIDGE.

Date	Hydrographer.	Discharge.
		Sec.-feet.
June 19, 1898	F. H. Olmsted	2.92
Aug. 28, 1898	do	1.27
July 28, 1900	S. G. Bennett	2.77
Aug. 30, 1901	J. B. Lippincott	2.08
Aug. 28, 1898	F. H. Olmsted	[a] 3.85
Oct. 25, 1900	K. Sanborn	[a] 8.45

SANTA ANA RIVER BELOW WEST RIVERSIDE BRIDGE.

July 30, 1900	S. G. Bennett	1.16
Aug. 30, 1901	J. B. Lippincott	1.19

SANTA ANA RIVER AT GALLIGERS FORD, 2 MILES BELOW WEST RIVERSIDE BRIDGE.

Aug. 30, 1899	S. G. Bennett	5.6

[a] Santa Ana River, West Riverside Bridge.

Discharge measurements of Trujillo ditch, tributary to Santa Ana.

Date.	Hydrographer	Discharge.
		Sec feet.
July 27, 1900	S. G. Bennett	0.46
Oct. 25, 1900	K. Sanborn	.53

Discharge measurement of Santa Ana River 1,000 feet below Roubidoux ditch intake.

Date	Hydrographer.	Discharge.
		Sec. feet.
Oct. 25, 1900	K. Sanborn	0.56

Discharge measurements of Santa Ana River in vicinity of Rincon, Riverside County.

ANAHEIM UNION CANAL.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
June 22, 1898	F. H. Olmsted	34.74	5 miles below division box.
Sept. 15, 1899	J. B. Lippincott	27.92	
Oct. 26, 1899	do	17.14	1 mile below Esperanza.
Aug. 15, 1900	W. P. Searcy	18.37	
Sept. 3, 1900	do	18.22	
Aug. 31, 1901	do	23.11	

SANTA ANA RIVER AT AUBURNDALE BRIDGE.

July 17, 1888	F. C. Finkle	14.6	
Aug. 22, 1888	do	13.3	
Sept. 15, 1888	do	14.2	
Aug. 14, 1889	do	15.6	
Sept. 28, 1889	do	16.7	
Aug. 13, 1890	do	22.3	
Sept. 10, 1891	do	25.6	
Sept. 11, 1892	do	43.4	
June 21, 1898	F. H. Olmsted	60.00	Including ditches.
Aug. 30, 1899	S. G. Bennett	53.10	Do.
Sept. 12, 1899	J. B. Lippincott	59.83	
July 28, 1900	S. G. Bennett	54.45	Do.
Oct. 5, 1900	W. W. Cockins, jr	69.70	Do.
Aug. 27, 1901	J. B. Lippincott	43.70	Above Roberts ditch.
Aug. 31, 1901	do	28.54	Do.

CASTILLO DITCH BELOW RIVERSIDE NARROWS.

Aug. 30, 1901	J. B. Lippincott	1.19	

CHINO CREEK NEAR RINCON.

Aug. 30, 1898	F. H. Olmsted	4.95	
May 2, 1899	F. Rolfe	12.79	
May 15, 1899	do	8.64	
June 3, 1899	do	17.02	
June 15, 1899	do	5.63	
July 4, 1899	do	3.02	
July 17, 1899	do	4.68	

Discharge measurements of Santa Ana River in vicinity of Rincon, etc.—Cont'd.

CHINO CREEK NEAR RINCON—continued.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. 1, 1899	F. Rolfe	7.49	
Aug. 15, 1899	do	2.14	
Aug. 31, 1899	do	3.19	
Sept. 13, 1899	J. B. Lippincott	3.53	
Oct. 25, 1899	do	14.52	
Apr. 17, 1900	W. P. Searcy	8.79	
June 24, 1900	do	3.97	
July 7, 1900	do	2.09	
July 28, 1900	S. G. Bennett	2.20	
Aug. 15, 1900	W. P. Searcy	1.08	
Sept. 3, 1900	do	0.0	
Oct. 5, 1900	W. W. Cockins, jr	5.00	
Aug. 31, 1901	J. B. Lippincott	2.80	

DIVISION BOX SANTA ANA AND ANAHEIM CANALS.

June 22, 1898	F. H. Olmsted	67.5	
Aug. 30, 1898	do	52.9	
Aug. 30, 1899	S. G. Bennett	59.6	
Sept. 15, 1899	J. B. Lippincott	71.7	
Oct. 25, 1899	do	144.7	
July 28, 1900	S. G. Bennett	49.7	
Oct. 5, 1900	W. W. Cockins, jr	75.1	
Aug. 27, 1901	J. B. Lippincott	64.5	
Aug. 31, 1901	do	55.4	

DURKEE DITCH.

Sept. 3, 1899	J. B. Lippincott	1.38	Near ranch house.
Sept. 13, 1899	do	6.14	Newberry east line.
July 28, 1900	S. G. Bennett	1.80	At ranch house.
Aug. 27, 1901	J. B. Lippincott	3.98	
Aug. 31, 1901	do	8.24	

SANTA ANA RIVER, OPPOSITE ESPERANZA STATION.

Oct. 26, 1899	J. B. Lippincott	49.2	

Discharge measurements of Santa Ana River in vicinity of Rincon, etc.—Cont'd.

FULLER DITCH.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
July 28, 1900		13.00	Said by Fuller to be carrying this amount at intake.
Oct. 5, 1900	W. W. Cockins, jr	6.50	
Aug. 30, 1901	J. B. Lippincott	9.69	Near intake.
Do	do	7.15	At Fuller's ranch house.

SANTA ANA RIVER, ABOVE FULLER'S DITCH.

Aug. 30, 1901	J. B. Lippincott	24.34	Intake.

GILLILAND'S DITCH, AUBURNDALE BRIDGE.

July 28, 1900	S. G. Bennett	1.40	

Discharge measurement of Santa Ana River, Newberry's east line.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. 31, 1901	J. B. Lippincott	40.7	

Discharge measurements of Newberry ditch.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
July 28, 1900	S. G. Bennett	5.47	At Auburndale bridge.
Aug. 27, 1901	J. B. Lippincott	3.05	At head.
Aug. 31, 1901	do	3.23	Do.

Discharge measurement of Newton ditch, below Narrows.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. 30, 1901	J. B. Lippincott	7.04	

Discharge measurements of Santa Ana River 1 mile below railroad bridge, Rincon, Cal.

Date.	Hydrographer.	Discharge.	Remarks.
1898.		*Sec.-feet.*	
June 21	F. H. Olmsted	[a] 79.81	
Do	do	[b] 3.18	
	Total	82.99	
Aug. 29	F. H. Olmsted	[a] 62.67	
Do	do	[b] 4.15	
	Total	66.82	
1899.			
Jan. 3	S. G. Bennett	[a] 209.4	
Do	do	[b] 2.3	
	Total	211.7	
Jan. 16	F. Rolfe	231.9	
Jan. 28	do	[a] 216.0	
Do	do	[b] 6.5	
	Total	222.5	
Feb. 15	F. Rolfe	[a] 181.0	
Do	do	[c] 1.75	
	Total	182.75	
Mar. 4	F. Rolfe total	108.6	
Mar. 18	do do	199.89	
Apr. 6	do	172.23	
	Total	480.72	
April 18	F. Rolfe	[a] 101.10	One mile below railroad bridge.
Do	do	[b] 2.75	
	Total	103.85	
May 2	F. Rolfe	[a] 100.34	
Do	do	[b] 2.45	
	Total	102.79	
May 15	F. Rolfe	[a] 100.36	
Do	do	[b] 3.95	
	Total	104.31	

[a] River. [b] Ditch. [c] Canal.

Discharge measurements of Santa Ana River, etc.—Continued.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
June 3	F. Rolfe	[a] 110.27	
Do	do	[b] 3.18	
	Total	113.45	
June 15	F. Rolfe	[a] 84.43	
Do	do	[b] 1.94	
	Total	86.37	
July 4	F. Rolfe	[a] 68.89	
Do	do	[b] 2.42	
	Total	71.31	
July 16	S. G. Bennett and F. Rolfe.	[a] 101.41	
Do	do	[b] 1.89	
	Total	103.30	
Do	S. G. Bennett and F. Rolfe.	[a] 87.89	
Do	do	[b] 1.65	
	Total	89.54	
July 18	F. Rolfe	[a] 64.13	One mile below railroad bridge.
Do	do	[b] 1.54	
	Total	65.67	
Aug. 1	F. Rolfe	[a] 57.82	
Do	do	[b] 3.44	
	Total	61.26	
Aug. 15	F. Rolfe	[a] 64.71	
Do	do	[b] 3.16	
	Total	67.87	
Aug. 30	F. Rolfe	[a] 65.90	
Do	do	[b] 2.00	
	Total	67.90	
Aug. 31	F. Rolfe	[a] 68.02	Do.
Do	do	[b] 3.06	
	Total	71.08	
Sept. 13	J. B. Lippincott	[a] 72.73	Do.
1900.			
Apr. 16	S. G. Bennett	90.86	Do.

[a] River. [b] Ditch.

Discharge measurements of Santa Ana River at Rincon wagon bridge.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
Sept. 13	J. B. Lippincott	72.58
Oct. 25	do	130.32
Oct. 26	do	146.53
Dec. 28	do	165.05
1900.		
Apr. 17	W. P. Searcy	101.60
June 24	do	69.20
July 7	do	84.47
July 28	S. G. Bennett	60.76
Aug. 15	W. P. Searcy	87.10
Sept. 3	do	88.20
Oct. 5	W. W. Cockins, jr	74.20
1901.		
Aug. 27	J. B. Lippincott	78.60
Aug. 31	do	65.30
1902.		
Sept. 2	W. B. Clapp	74.90

Discharge measurements of Santa Ana River at Riverside Narrows.

Date.	Hydrographer.	Discharge.
1888.		*Sec.-feet.*
July 16	F. C. Finkle	10.1
July 17	do	10.5
Aug. 21	do	8.5
Sept. 14	do	9.5
1889.		
Aug. 13	do	11.0
Sept. 27	do	11.2
1890.		
Aug. 12	do	18.8
1901.		
Sept. 9	do	15.5
1892.		
Sept. 10	do	29.4

Discharge measurements of Santa Ana River at Riverside Narrows—Continued.

Date.	Hydrographer.	Discharge.
1898.		*Sec.-feet.*
June 20	F. H. Olmsted	47.63
Aug. 29	do	39.05
1899.		
July 17	F. Rolfe	31.70
Sept. 9	J. B. Lippincott	39.69
1900.		
July 27	S. G. Bennett	38.41
Oct. 25	K. Sanborne	70.64
1901.		
Aug. 30	J. B. Lippincott	33.87
1902.		
Oct. 10	K. Sanborne	43.25

Discharge measurements of canals and ditches of Santa Ana River system near Rincon, Riverside County.

DITCH ON RIGHT BANK OF SANTA ANA RIVER 3 MILES BELOW RIVERSIDE NARROWS.

Date.	Hydrographer.	Discharge.
1898.		*Sec.-feet.*
June 20	F. H. Olmsted	3.75

DITCH ON RIGHT BANK OF SANTA ANA RIVER 5 MILES BELOW RIVERSIDE NARROWS, ON GRIFFITH'S PLACE.

June 20	F. H. Olmsted	9.99

ROBERTS DITCH.

1901.		
Aug. 27	J. B. Lippincott	0
Aug. 31	do	0

Discharge measurements of canals and ditches, etc.—Continued.

SANTA ANA VALLEY IRRIGATION COMPANY'S CANAL, ORANGE COUNTY, CAL.

Date.	Hydrographer.	Discharge.
1898.		*Sec.-feet.*
June 22	F. H. Olmsted	[a] 28.99
Aug. 30	do	[a] 24.62
1899.		
May 26	F. Rolfe	[b] 43.98
Sept. 15	J. B. Lippincott	30.26
Oct. 26	do	[c] 47.19
1900.		
Sept. 3	W. P. Searcy	38.99
Aug. 15	do	25.71
1901.		
Aug. 31	J. B. Lippincott	[d] 18.30

SEECHER DITCH, AT RINCON BRIDGE.

1901.		
June 24	W. P. Searcy	.62

TOWNSEND DITCH.

1898.		
June 20	F. H. Olmsted	4.80
1900.		
Oct. 5	W. W. Cockins, jr	5.84

WILBUR DITCH.

1901.		
Aug. 30	J. B. Lippincott	4.52

YORBA DITCH

1899.		
Oct. 26	J. B. Lippincott	8.88
1900.		
Aug. 15	W. P. Searcy	14.00
Sept. 3	do	21.45
1901.		
Aug. 31	J. B. Lippincott	[e] .40

[a] Near bridge to Yorba.
[b] Three miles above Olive.
[c] First road crossing.
[d] At road crossing at head of cement lining.
[e] Estimated above drop from Anaheim ditch and opposite Esperanza.

Miscellaneous low-water measurements made in watershed of Santa Ana River, Los Angeles, San Bernardino, Riverside, and Orange counties.

Date.	Locality.	Area of section.	Mean velocity.	Discharge.
1900.		*Sq. feet.*	*Feet per sec.*	*Sec.-feet.*
ept. 25	Frey's ranch, near Spadra	0.80	2.312	1.85
Do	Phillips's ranch, near Spadra (weir)			.74
ept. 27	C. L. Lancaster, Mesa avenue, Lordsburg (weir)			.559
ept. 26	Covina Irrigation Co. compressor pumping plant, south of Lordsburg			3.58
ept. 24	Neuruff place, corner Holt avenue and San Antonio avenue, Pomona (weir)			.33
ept. 26	Pomona Land and Water Co., Garey avenue (weir)			1.28
ept. 26	Consolidated Water Co.'s Pomona air-compressor plant (weir)			3.34
ept. 24	Consolidated Water Co., north of Pomona College (weir)			.82
ept. 25	James Warden's place (weir)			.25
ept. 24	Brundege place, San Antonio avenue, Pomona	.25	1.04	.26
ept. 25	Del Monte Water Co. (weir)			.96
Do	San Antonio Water Co.'s wells in Claremont; water goes to Ontario (weir)			.40
Do	San Antonio Water Co.'s wells at Indian Hill, ½ mile north of Pomona College (weir)			.99
Do	San Antonio Canyon. From records of Pomona Land and Water Co. The discharge from San Antonio Canyon was 7.53 second-feet Sept. 2, 1895, and 9.02 second-feet on Sept. 6, 1897 (weir).[a]			3.72
	RED HILL, CUCAMONGA.			
uly 11	Cucamonga Land and Water Co., Cucamonga Creek, 30-inch pipe line (weir)			1.15
Do	Cucamonga Land and Water Co., Lone Star Spring pumping plant (weir)			1.20
Do	Cucamonga Land and Water Co., "Y" tunnel (weir)			1.68
Do	Stowell water from 90-acre tract; west side part to Ontario (weir)			2.97
Do	San Antonio Water Co., Haskell well (weir)			2.13
Do	San Antonio Water Co., Sixteenth street, pumping plant (weir)			1.72
	Total			10.85

[a] July 11, 1900, measurement made of water in San Antonio Canyon by S. G. Bennett; discharge, 07 second-feet.

Miscellaneous low-water measurements made, etc.—Continued.

Date.	Locality.	Area of section.	Mean velocity.	Discharge.
1900.	RED HILL, CUCAMONGA—continued.			
July 11	Natural surface flow of Cucamonga Creek in canyon (Ionosa Water Co.)	*Sq. feet.* 0.22	*Feet per sec.* 4.10	*Sec.-feet.* 0.90
	Developed by bed-rock tunnel			.18
	Total			1.08
Aug. 1	Cucamonga Land and Water Co., Lone Star Spring pumping plant (weir)			1.02
June 8	Lytle Creek at intake of Rialto Canal (weir)			6.19
Sept. 29	do			4.62
June 8	Cajon Creek Canyon in flume, opposite Keenbrook station	1.49	.92	1.37
July 12	West Twin Creek in flume	.084	2.66	.22
Oct. 1	do			.16
July 12	East Twin Creek, Del Rosa cement canal	.40	1.55	.62
Oct. 1	do			.36
July 12	East Twin Creek, Kansas City Syndicate development	.44	3.45	.15
Oct. 1	do			.17
July 12	City Creek measurement in cement canal	.32	.50	.16
Oct. 1	City Creek, at head of pipe line	.24	.88	.21
July 12	Plunge Creek at intake of ditch (weir)			.34
July 13	Below wasteway of Santa Ana Canal	9.29	2.404	22.34
Do	South Fork or Redlands Canal, water not going over weir into North Fork or Highlands Canal on account of repairs (weir)			10.65
Do	Redlands tunnel (weir)			.84
Do	Morton Canyon (weir)			.09
Oct. 2	South Fork or Redlands Canal (weir)			6.25
Do	North Fork or Highlands Canal (weir)			5.61
Do	Green Spot pipe line (weir)			.12
Do	Redlands tunnel (weir)			.85
Do	Morton Canyon (weir)			.20
July 13	Water in Mill Creek zanja (weir)			5.35
Do	Mill Creek. Water is being pumped by Crafton Water Co. et al. in Mill Creek Canyon and Yucipe Valley (weir)			3.44
	Total			8.79

Miscellaneous low-water measurements made, etc.—Continued.

Date.	Locality.	Area of section.	Mean velocity.	Discharge.
1900.	RED HILL, CUCAMONGA—continued.			
Oct. 2	Crafton Water Co.'s pumping plant, Mill Creek Canyon (weir)	*Sq. feet.*	*Feet per sec.*	*Sec.-feet.* 1.35
Do	At mouth of Mill Creek Canyon (weir)			7.21
	Total			8.56
July 14	San Timoteo Canyon ditch at Bicknell Station	1.00	1.50	1.50
June —	Haws & Talmadge			.00
June —	Rabel ditch			.35
June —	Shay ditch			.40
June —	McKenzie ditch			1.57
June —	Meeks & Daley ditch			13.78
June —	Beams ditch			.50
June —	Riverside Water Co., upper canal			52.94
June —	Riverside Water Co., lower canal			7.16
June —	Timber ditch			.00
June —	Gage Canal, Santa Ana River			.29
June —	Gage Canal, Palm avenue			22.52
June —	Logsdon & Farrel ditch			.49
June —	Whitlock ditch			.00
June —	Daley ditch			1.12
June —	McIntyre ditch			.01
June —	Whiting ditch			.13
June —	Swamp ditch			.89
June —	Ranchero ditch			.55
June —	Ward & Warren ditch			1.70
June —	Mill flume, Riverside Water Co			2.17
June —	Mill pump, Riverside Water Co			1.88
June —	Camp Carlton ditch			2.60
June —	East Riverside ditch			5.38
June —	Colton Terrace Water Co			1.54
June —	City of Colton			3.21
June —	Bloomington flume			3.68
July 26	Riverside Water Co.'s upper canal in flume 150 feet above tunnel Riverside Mesa	17.48	2.477	43.30
July 27	North Riverside and Jurupa Canal in flume near Beckstead's house	6.94	2.077	14.42
July 27	Riverside Water Co.'s lower canal	3.35	2.128	7.13
July 27	Roubidoux ditch	6.21	1.317	8.18
July 27	Trujillo ditch	.75	.61	.46

Miscellaneous low-water measurements made, etc.—Continued.

Date	Locality.	Area of section.	Mean velocity.	Discharge.
1900.	RED HILL, CUCAMONGA—continued.	*Sq. feet.*	*Feet per sec.*	*Sec.-feet.*
July 27	75 feet below intake of Trujillo ditch	0.38	1.17	0.44
July 27	Evans upper ditch	.95	1.10	1.04
	Total flow Santa Ana at Roubidoux ditch intake			10.12
July 27	Alsetrez ditch from Spring Brook, 100 feet below West Riverside bridge	1.95	1.42	2.77
July 27	200 feet below West Riverside bridge	1.77	.65	1.16
July 27	West Riverside bridge, Roubidoux Mountain	2.85	1.85	5.27
July 27	At Riverside Narrows	26.54	1.443	38.41
Sept. 13	Riverside Water Co.'s lower canal	3.36	1.99	6.69
Oct. 19	North Riverside and Jurupa canal	6.69	2.10	14.05
Oct. 25	Roubidoux ditch	5.95	1.31	7.80
Oct. 25	Trujillo ditch	1.10	.48	.53
Oct. 25	20 feet below intake of Trujillo ditch	.80	.70	.56
Oct. 25	Evans's upper ditch	2.42	1.37	3.32
	Total			12.21
Oct. 25	Alsetrez ditch from Spring Brook, West Riverside bridge	1.75	.87	1.53
Oct. 25	At West Riverside bridge	5.50	1.54	8.45
Oct. 25	Evans's ditch, West Riverside bridge	2.52	1.75	4.36
Oct. 25	At Riverside Narrows	43.3	1.63	70.64
July 28	300 feet above Auburndale bridge	28.65	1.576	45.16
July 28	Newberry ditch, Auburndale bridge	5.32	1.03	5.47
July 28	Ditch south of Newberry ditch, Auburndale bridge	1.58	1.47	2.32
July 28	Gilliland ditch, Auburndale bridge	1.49	.94	1.40
	Total			54.35
Oct. 5	Auburndale bridge	40.50	1.577	63.9
Oct. 5	Townsend ditch, Auburndale bridge	6.10	.957	5.84
Oct. 5	Fuller's ditch, near schoolhouse	5.10	1.274	6.50
July 28	Rincon bridge	35.55	1.704	60.76
July 28	Chino Creek under bridge, Chino-Corona road	3.66	.60	2.20
Oct. 5	Rincon bridge	43.90	1.69	74.20
Oct. 5	Chino Creek	1.90	2.63	5.00
July 28	Durkee ditch, near ranch house	1.40	1.30	1.80
July 28	At Anaheim and Santa Ana division box	23.64	2.103	49.72
Oct. 5	do	29.00	2.59	75.10

For tabulation of a large number of water measurements in the San Bernardino Valley above Riverside Narrows and in the basin of the Santa Ana River, see San Bernardino Valley.

SANTA ANA RIVER, MILL CREEK.

See Mill Creek (page 158).

SANTA ANA RIVER, LYTLE CREEK.

See Lytle Creek (page 139).

SANTA ANA RIVER, SAN ROQUE CREEK.

See Arroyo Burro (page 43).

SANTA BARBARA COUNTY.

Miscellaneous measurements of streams east of Santa Barbara City, Santa Barbara County, made in July and August, 1889, by George F. Wright.

Stream.	Discharge.	Area of watershed.
	Sec.-feet.	*Sq. miles.*
Rincon	0.12	10.5
Gubernador	.58	4.2
Carpenteria	.08	44.0
Santa Monica	.23	4.3
Padaro	.31	2.2
Dinsmore	.23	2.2
Cold Stream	.23	3.0
Mission	.46	4.0

Miscellaneous measurements of streams west of Santa Barbara City, Santa Barbara County, made in July and August, 1889, by George F. Wright.

Stream.	Discharge.	Area of watershed.
	Sec.-feet.	*Sq. miles.*
Arroyo Burro	0.23	2.5
Maria Ignacia	.23	16.5
San Jose	.27	.....
San Pedro	.08	3.0
Arroyo Carnero	.08	1.0
Armas	.08	1.0
Tecolote	.27	2.0
Aguilar	.12	2.0
Dos Pueblos	.54	3.25
Canyada Verde	.08	2.00
Canyada Llaces	.08	1.50
El Capitan	.23	1.50
Canyada del Corral	.15	1.00
Canyada Refugio	.31	2.00

Discharge measurements of San Pedro Creek, Santa Barbara County, Cal.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. , 1889	G. F. Wright	0.08	Drainage area, 3 square miles.

Discharge measurements of San Timoteo Creek, Riverside County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
July 14, 1900	S. G. Bennett	1.50	Bicknel station.

Discharge measurements of San Ysidro Creek, Santa Barbara County, Cal., above dam.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Nov. 2, 1899	Greenheld	0.06	
Dec. 3, 1899	do	.15	
Mar. 6, 1900	do	1.00	
Mar. 19, 1900	do	.35	
June 16, 1900	R. Moyer	.07	

SANTA CLARA RIVER.

Discharge measurements of Santa Clara River at point below mouth of San Francisquito Creek, on Newhall ranch, Los Angeles County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. 9, 1898	F. H. Olmsted	10.83	
Aug. 19, 1899	S. G. Bennett	3.38	East channel.
Aug. 19, 1899	do	1.65	West channel.
Aug. 19, 1899	do	3.37	Newhall ditch.
	Total	8.40	
Oct. 8, 1900	W. W. Cockins, jr	3.64	East channel.
Oct. 8, 1900	do	3.25	West channel.
Oct. 8, 1900	do	3.35	Newhall ditch.
	Total	10.24	

Discharge measurements of Santa Clara River at point 2 miles east of Camulos, Ventura County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
June 18, 1898	J. B. Lippincott	25.74	
Aug. 11, 1898	F. H. Olmsted	17.36	
Aug. 19, 1899	S. G. Bennett	17.63	Camulos ditch.
Aug. 19, 1899	do	1.24	River.
	Total	18.87	
Oct. 8, 1900	W. W. Cockins, jr	11.38	Camulos ditch at head of wooden flume.

Discharge measurements of Santa Clara River in Cienega, 1 mile east of Fillmore, Ventura County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Mar. 15, 1899	S. G. Bennett	3.60	

Discharge measurements of Santa Clara River near Santa Paula, Ventura County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. 18, 1899	S. G. Bennett	16.00	Farmers ditch.
Aug. 18, 1899	do	8.60	Grease or Santa Clara ditch.
Aug. 18, 1899	do	5.80	Ditch taken out on east side of river.
Aug. 18, 1899	do	10.30	River.
	Total	40.70	

SANTA MONICA CREEK.

Discharge measurements of Santa Monica Creek, Santa Barbara County.

[Drainage, 4.3 square miles.]

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Aug. —, 1889	G. F. Wright	0.23	¼ mile above Fithian's house.
June 16, 1900	R. Moyer	.11	

SANTA PAULA RIVER.

Discharge measurement of Santa Paula River above Neeper schoolhouse, near Santa Paula, Ventura County, Cal.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. 18, 1899	S. G. Bennett	0.85	

SANTA YNEZ RIVER.

As determined from Geological Survey maps the area of the drainage basin of this stream above Juncal dam site is 13.4 square miles. E. J. S. Purslow stated in a report to the Santa Barbara Water Company in 1896 that the Santa Ynez River at the Juncal reservoir site was measured during the "past winter and spring;" further details are not given. The discharge stated was 800,000,000 gallons=2,455 acre-feet. The rainfall for season at Santa Barbara was 13.77 inches and the mean from 1867 to date is 16.82 inches. The period of stream observations probably extended from November 1, 1895, to July 1, 1896. This includes Alder Creek water below Juncal.

During the winter of 1902–3 the city of Santa Barbara cooperated with the United States Geological Survey in determining the run-off from portions of the drainage basin of the Santa Ynez River, as given below.

Measurements were first made of the main Santa Ynez River above its junction with the Mono tributary. The drainage area above this point is 71 square miles. Measurements were also made of the discharge of the Mono tributary of the Santa Ynez River at its mouth. The drainage area above this point is 119 square miles. Both of these streams flow from the mountains of the Coast Range, the elevations of their basins ranging from 1,400 to 7,000 feet.

The estimated average rainfall in these drainage basins is 22 inches and during the season of 1902–3 the mean rainfall was probably exceeded by about 2 inches. The precipitation, however, occurred in gentle slow storms until the latter part of March, when there were heavier rains. It is locally stated that the stream flow is not up to the average. This probably could be explained by the fact of the gentle rains referred to above, and to the further fact that the season of 1902–3 was preceded by years of protracted drought.

List of discharge measurements of Santa Ynez River above junction with Mono.

Date.	Hydrographer.	Gage height.	Discharge.
1903.		*Feet.*	*Sec.-feet.*
Jan. 12	Howard Rankin	1.10	1.79
Jan. 25	do	1.10	1.93
Jan. 27	do	1.20	3.30
Jan. 28	do	3.55	457.24
Jan. 29	do	1.70	49.75
Jan. 30	do	1.50	22.45
Jan. 31	do	1.48	17.90
Feb. 1	do	1.50	22.18
Feb. 2	do	1.45	16.01
Feb. 3	do	1.42	14.61
Feb. 4	do	1.45	15.31
Feb. 5	do	1.45	14.92
Feb. 7	do	1.45	15.63
Feb. 8	do	1.58	24.74
Feb. 9	do	1.50	18.38
Feb. 10	do	1.49	17.63
Feb. 11	do	1.46	16.15
Feb. 12	do	1.45	15.54
Feb. 13	do	1.44	14.92
Feb. 14	do	1.44	14.72
Feb. 16	do	1.40	10.85
Feb. 17	do	1.40	11.34
Feb. 18	do	1.40	11.11
Feb. 19	do	1.40	11.05
Feb. 20	do	1.39	10.75
Feb. 21	do	1.39	10.98
Feb. 23	do	1.38	10.11
Feb. 24	do	1.37	9.05
Feb. 25	do	1.37	9.07
Feb. 26	do	1.36	8.58
Feb. 27	do	1.35	8.72
Feb. 28	do	1.35	8.32
Mar. 1	do	1.35	8.16
Mar. 2	do	1.35	8.01
Mar. 3	do	1.35	7.91
Mar. 4	do	1.45	14.78
Mar. 5	do	1.65	31.60
Mar. 6	do	1.50	20.19
Mar. 7	do	1.50	19.95
Mar. 9	do	1.43	13.52
Mar. 10	do	1.42	13.20
Mar. 11	do	1.42	13.42

List of discharge measurements of Santa Ynez River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1903.		*Feet.*	*Sec.-feet.*
Mar. 12	Howard Rankin	1.41	12.70
Mar. 13	do	1.42	13.24
Mar. 14	do	1.43	12.84
Mar. 15	do	1.43	13.11
Mar. 16	do	1.43	12.85
Mar. 17	do	1.42	11.63
Mar. 18	do	1.41	11.27
Mar. 19	do	1.40	11.08
Mar. 20	do	1.40	10.88
Mar. 21	do	1.40	10.55
Mar. 22	do	1.40	10.48
Mar. 23	do	1.40	10.60
Mar. 25	do	1.67	29.26
Mar. 26	do	1.55	19.58
Mar. 27	do	1.50	17.15
Mar. 28	do	1.49	16.91
Mar. 29	do	1.50	18.05

List of discharge measurements of Mono Creek at mouth.

Date.	Hydrographer.	Gage height.	Discharge.
1903.		*Feet.*	*Sec.-feet.*
Jan. 28	Howard Rankin	2.95	295.00
Jan. 29	do	1.55	20.23
Jan. 30	do	1.30	12.51
Jan. 31	do	1.25	9.03
Feb. 1	do	1.35	14.83
Feb. 2	do	1.30	10.12
Feb. 3	do	1.20	6.93
Feb. 4	do	1.28	8.82
Feb. 5	do	1.28	8.25
Feb. 6	do	1.21	8.08
Feb. 8	do	1.35	11.96
Feb. 9	do	1.29	8.81
Feb. 10	do	1.28	8.42
Feb. 11	do	1.27	8.77
Feb. 12	do	1.26	8.23
Feb. 13	do	1.25	7.61
Feb. 14	do	1.20	4.89
Feb. 16	do	1.20	5.10
Feb. 17	do	1.20	5.04

List of discharge measurements of Mono Creek at mouth—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1903.		*Feet.*	*Sec.-feet.*
Feb. 18	Howard Rankin	1.20	5.14
Feb. 19	do	1.20	5.17
Feb. 20	do	1.19	4.75
Feb. 21	do	1.19	4.74
Feb. 23	do	1.17	4.65
Feb. 24	do	1.15	4.60
Feb. 25	do	1.15	4.56
Feb. 26	do	1.15	4.45
Feb. 27	do	1.14	3.79
Feb. 28	do	1.14	3.81
Mar. 1	do	1.12	3.61
Mar. 2	do	1.12	3.62
Mar. 3	do	1.12	3.64
Mar. 4	do	1.30	10.99
Mar. 5	do	1.60	25.85
Mar. 6	do	1.37	13.57
Mar. 7	do	1.35	13.28
Mar. 9	do	1.30	9.77
Mar. 10	do	1.25	6.58
Mar. 11	do	1.22	6.32
Mar. 12	do	1.22	6.56
Mar. 13	do	1.22	6.49
Mar. 14	do	1.27	9.22
Mar. 15	do	1.25	7.52
Mar. 16	do	1.30	9.83
Mar. 17	do	1.32	9.94
Mar. 18	do	1.26	8.19
Mar. 19	do	1.25	7.99
Mar. 20	do	1.24	7.08
Mar. 21	do	1.24	7.07
Mar. 22	do	1.23	7.18
Mar. 23	do	1.23	7.17
Mar. 25	do	2.50	153.23
Mar. 26	do	1.90	62.52
Mar. 27	do	1.70	36.27
Mar. 28	do	1.60	26.63
Mar. 29	do	1.61	29.54
Mar. 30	do	2.65	177.46
Mar. 31	do	2.80	227.31
Apr. 1	do	4.50	710.58
Apr. 2	do	3.00	269.83

SAWPIT CREEK.

Discharge measurement of Sawpit Creek at Division Box, Los Angeles County, Cal.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
July 1, 1898	F. H. Olmsted	1.33	Near mouth of canyon.

SESPE CREEK.

Discharge measurements of Sespe Creek, Santa Clara River, Ventura County, Cal.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. 11, 1898	F. H. Olmsted	2.5	
Mar. 15, 1899	S. G. Bennett	8.3	At head of Sespe Land and Water Co. Canal.
Aug. 18, 1899	do	1.9	Do.

SHASTA RIVER.

Discharge measurement of Shasta River.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Aug. —, 1899	M. M. O'Shaughnessy	279	Wagon bridge 1 mile south of Montague railroad station.

SNOW CREEK.

Discharge measurement of Snow Creek, Palm Valley, Riverside County, Cal.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Feb. 22, 1898	J. B. Lippincott	4.5	

SPRING VALLEY WATER COMPANY.

See San Mateo Creek, Water Supply and Irrigation Paper No. 51, page 390.

STANISLAUS RIVER.

The river has its source on the western slope of the Sierra Nevada in California. It drains a country lying between the basins of Mokelumne River on the north and Tuolumne River on the south, and flows in a general southwesterly direction, entering San Joaquin River 23 miles above Stockton. A number of canals divert water from this stream on either side, the principal one being the canal of the Stanislaus and San Joaquin Water Company, which irrigates lands in the vicinity of Oakdale and between Knights Ferry and Stockton.

The canal of the Stanislaus and San Joaquin Water Company diverts water from Stanislaus River at a point 3 miles above Knights Ferry, or approximately 15 miles above Oakdale. The volume of this canal at what is known as section 3, was rated on June 1, 1898, by turning in various amounts of water and measuring the same with a meter. It was found on June 6, 1899, that silt had accumulated in the bottom of the flume at the old gage, and a new station was adopted. This point was rated similarly to the one of the year previous.

The record at this station was discontinued February 16, 1901.

Discharge measurements of Stanislaus River at Oakdale, Stanislaus County.

Date.	Hydrographer.	Gage height.	Discharge.
1895.		*Feet.*	*Sec.-feet.*
May 3	J. B. Lippincott	8.85	7,744
July 1	do	6.17	3,754
Aug. 28	do	2.40	279
Oct. 10	do	2.11	192
Nov. 29	do	2.12	147
1896.			
Apr. 17	J. A. Vogleson	5.40	2,801
July 5	C. C. Babb	4.80	2,061
Sept. 7	H. Crowe	2.50	304
Oct. 29	J. B. Lippincott	2.40	210
1897.			
Feb. 16	J. B. Lippincott	4.22	1,346
June 30	J. B. Lippincott and B. Cole	8.60	6,754
July 14	A. Q. Campbell	3.20	1,015
Sept. 5	do	2.00	144
Oct. 29	do	2.40	223
Dec. 19	J. B. Lippincott	3.00	429

Discharge measurements of Stanislaus River at Oakdale, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1898.		*Feet.*	*Sec.-feet.*
Apr. 17	J. B. Lippincott	5.30	2,203
June 2	do	3.77	912
July 29	do	[a] 4.30	73
Oct. 6	do	4.20	50
Dec. 22	do	4.97	362
1899.			
Mar. 3	J. B. Lippincott	5.13	487
Apr. 20	S. G. Bennett	8.80	3,873
May 18	do	7.63	2,634
June 5	do	7.94	3,057
June 8	do	8.42	3,599
June 28	do	6.3	1,167
Aug. 3	do	4.53	143
Sept. 9	do	4.41	88
Dec. 6	J. B. Lippincott	5.41	531
1900.			
Apr. 5	S. G. Bennett	6.82	1,703
May 19	do	9.33	4,515
June 21	do	6.65	1,438
Aug. 11	do	4.38	66
Sept. 6	do	4.25	35
Dec. 28	do	5.66	611
1901.			
Jan. 29	S. G. Bennett	6.18	965
Oct. 21	do	4.78	189
1902.			
Aug. 20	L. M. Lawson	.....	125

[a] New rod set July 20, 1898

Discharge measurements of Stanislaus River at Parrots Ferry.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
Sept. 13	S. G. Bennett	70

Estimated monthly discharge of Stanislaus River at Oakdale, Stanislaus County. [a]

[Drainage area, 1,051 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November [b]			42	2,499	0.04	0.04
December [b]			42	2,582	.04	.05
1879.						
January [b]			525	32,281	.50	.58
February	9,830	350	1,994	110,741	1.89	1.97
March	6,960		4,523	278,108	4.30	4.96
April	7,390	3,260	4,307	256,284	4.09	4.56
May	6,060	2,950	4,098	251,976	3.90	4.50
June	6,720	3,160	4,387	261,044	4.17	4.65
July	2,230	1,320	1,584	97,396	1.51	1.74
August [b]			126	7,747	.12	.14
September [b]			21	1,249	.02	.02
October [b]			21	1,291	.02	.02
November [b]			74	4,403	.07	.08
December [b]			630	38,737	.60	.69
The year			1,858	1,341,257	1.77	23.91
1880.						
January [b]			315	19,369	0.30	0.35
February [b]			526	30,256	.50	.53
March [b]			630	38,737	.60	.69
April [b]			5,781	343,993	5.50	6.14
May	10,980	4,370	7,251	445,846	6.90	7.96
June	10,820	5,240	7,742	460,681	7.37	8.22
July	4,630	1,680	3,255	200,142	3.10	3.57
August			735	45,193	.70	.81
September			74	4,403	.07	.08
October			32	1,967	.03	.03
November [b]			21	1,249	.02	.02
December [b]			630	38,737	.60	.69
The year			2,249	1,630,573	2.14	29.09

[a] Authority: California State engineering department from November, 1878, to October, 1884; United States Geological Survey from June, 1895, to December, 1900.

[b] Estimated from run-off of neighboring streams and from previous measurements.

Estimated monthly discharge of Stanislaus River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1881.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January [a]			2,102	129,247	2.00	2.31
February [a]			5,255	291,847	5.00	5.21
March [a]			2,102	129,247	2.00	2.31
April [a]			4,729	281,394	4.50	5.02
May [a]			5,255	323,117	5.00	5.76
June [a]			2,733	162,625	2.60	2.90
July			960	59,028	.91	1.05
August			360	22,136	.34	.39
September			140	8,330	.13	.15
October			120	7,378	.11	.13
November			150	8,925	.14	.16
December			1,488	91,493	1.42	1.64
The year			2,116	1,514,767	2.01	27.03
1882.						
January			398	24,472	0.38	0.44
February			908	50,428	.86	.89
March			4,771	293,357	4.54	5.23
April			3,782	225,044	3.60	4.02
May			5,155	316,968	4.91	5.66
June [a]			5,255	312,694	5.00	5.58
July [a]			1,892	116,334	1.80	2.08
August [a]			105	6,456	.10	.12
September [a]			105	6,248	.10	.11
October [a]			473	29,083	.45	.52
November [a]			368	21,897	.35	.39
December [a]			210	12,912	.20	.23
The year			1,951	1,415,893	1.85	25.27

[a] Estimated from run-off of neighboring streams and from previous measurements.

Estimated monthly discharge of Stanislaus River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			525	32,281	0.50	0.58
February [a]			420	23,325	.40	.42
March [a]			840	51,649	.80	.92
April [a]			2,102	125,078	2.00	2.23
May [a]			5,255	323,117	5.00	5.76
June [a]			4,204	250,155	4.00	4.46
July [a]			1,051	64,623	1.00	1.15
August [a]			315	19,368	.30	.35
September [a]			210	12,496	.20	.22
October [a]			168	10,330	.16	.18
November [a]			210	12,496	.20	.22
December [a]			210	12,912	.20	.23
The year			1,292	937,830	1.23	16.72
1884. [a]						
January			263	16,171	0.25	0.29
February			3,153	181,362	3.00	3.24
March			4,204	258,494	4.00	4.61
April			4,729	281,394	4.50	5.02
May			4,729	290,775	4.50	5.19
June			5,255	312,694	5.00	5.58
July			4,204	258,494	4.00	4.61
August			1,051	64,623	1.00	1.15
September			210	12,496	.20	.22
October			158	9,715	.15	.17
1895.						
June	8,510	3,842	5,686	338,340	5.41	6.04
July	3,842	550	1,778	109,330	1.69	1.95
August	550	145	330	20,304	.31	.36
September	3,161	145	638	37,970	.61	.68
October	246	145	176	10,802	.17	.19
November	179	179	179	10,651	.17	.19
December	414	145	198	12,208	.19	.22

[a] Estimated from run-off of neighboring streams and from previous measurements.

Estimated monthly discharge of Stanislaus River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1896.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	6,956	150	1,806	111,058	1.72	1.98
February	1,208	632	782	45,038	.75	.80
March	12,000	694	2,464	151,505	2.35	2.70
April	9,050	1,966	3,274	194,870	3.11	3.48
May	13,050	2,290	4,717	290,092	4.57	5.17
June	11,000	2,656	6,541	389,247	6.22	6.97
July	3,156	470	1,293	79,503	1.23	1.42
August	2,412	218	385	23,703	.37	.42
September	962	252	332	19,761	.32	.35
October	370	218	239	14,695	.22	.26
November	4,514	252	705	41,968	.67	.75
December	1,750	470	681	41,904	.65	.75
The year	13,050	150	1,935	1,403,344	1.85	25.05
1897.						
January	2,251	410	609	37,446	0.58	0.67
February	10,580	1,264	3,252	180,607	3.10	3.23
March	5,062	1,264	1,915	117,750	1.82	2.10
April	9,234	1,880	5,064	301,328	4.81	5.37
May	9,980	5,480	7,324	450,338	6.97	8.04
June	3,974	860	2,077	123,590	1.98	2.21
July	1,180	250	582	35,786	.55	.63
August	230	170	198	12,175	.19	.22
September	190	140	152	9,045	.14	.16
October	250	140	176	10,822	.17	.20
November	780	170	255	15,174	.24	.27
December	1,516	210	411	25,272	.39	.45
The year	10,580	140	1,835	1,319,333	1.74	23.55

Estimated monthly discharge of Stanislaus River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1898.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec. feet.*	*Inches.*
January	336	74	207	12,728	0.20	0.23
February	1,372	156	389	21,604	.37	.39
March	1,000	336	572	35,171	.54	.62
April	3,920	536	1,813	107,881	1.73	1.93
May	2,540	536	1,378	84,730	1.31	1.51
June	880	480	647	38,499	.62	.69
July	384	74	167	10,268	.16	.18
August	100	27	66	4,058	.06	.07
September	100	50	61	3,630	.06	.07
October	100	74	77	4,735	.07	.08
November	100	50	71	4,225	.07	.08
December	315	74	139	8,547	.13	.15
The year	3,920	27	466	336,076	.44	6.00
1899.						
January	1,240	70	457	28,100	0.44	0.51
February	690	130	355	19,716	.34	.35
March	13,940	220	2,425	149,108	2.31	2.66
April	5,270	1,450	3,525	209,752	3.35	3.74
May	5,780	1,450	2,559	157,348	2.43	2.80
June	4,632	1,045	2,663	158,459	2.53	2.82
July	1,120	175	502	30,867	.48	.55
August	265	90	150	9,223	.14	.16
September	130	50	85	5,058	.08	.09
October	1,200	90	309	19,000	.29	.33
November	2,340	90	1,092	64,978	1.04	1.16
December	5,015	550	1,461	89,834	1.39	1.60
The year	13,940	50	1,299	941,443	1.24	16.77

Estimated monthly discharge of Stanislaus River, etc.—Continued.

Month	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1900.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	7,050	820	1,944	119,532	1.85	2.13
February	1,100	540	700	38,876	.67	.70
March	2,640	540	1,829	112,461	1.74	2.01
April	3,000	1,260	1,761	104,787	1.68	1.87
May	4,377	1,260	3,343	205,553	3.18	3.67
June	3,125	960	1,863	110,856	1.77	1.97
July	960	70	349	21,459	.33	.38
August	110	30	64	3,935	.06	.07
September	70	30	46	2,737	.04	.04
October	2,760	70	448	27,546	.43	.49
November	6,037	310	1,220	72,595	1.16	1.29
December	1,640	610	871	53,556	.83	.95
The year	7,050	30	1,203	873,893	1.15	15.57

Discharge measurement of Cascade Creek, Stanislaus River, Tuolumne County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Oct. 21, 1896	J. B. Lippincott	0.0

Discharge measurement of Cow Creek, Stanislaus River, Tuolumne County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Oct. 21, 1896	J. B. Lippincott	0.5

Discharge measurement of Stanislaus River, Main Fork, Eureka Valley, Tuolumne County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Nov. 20, 1896	J. B. Lippincott	158.0

Discharge measurement of Mill Creek, Stanislaus River, Tuolumne County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Oct. 21, 1896	J. B. Lippincott	1.5	

Discharge measurement of Niagara Creek, Stanislaus River, Tuolumne County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Oct. 21, 1896	J. B. Lippincott	1.5	

Discharge measurement of Stanislaus River, Middle Fork, Donnels Flat, near mouth of Niagara Creek, Tuolumne County.

Date.	Hydrographer.	Discharge.	Remarks.
		Sec.-feet.	
Oct. 12, 1899	Mr. Coul	144	Mean of 12 measurements not influenced by reservoired water; no diversion above.

Discharge measurement of Stanislaus River, Middle Fork, north of Shot Gun, Tuolumne County.

Date.	Hydrographer.	Discharge.	Remarks.
1901.		*Sec. feet.*	
Sept. 16, 17	C. E. Moore	300	

Discharge measurement of Stanislaus River, Oakdale Ditch Company's Flume, Stanislaus County.

Date	Hydrographer.	Gage height.	Discharge.	Remarks
1899.		*Feet.*	*Sec.-feet.*	
May 19	S. G. Bennett		10.6	
1902.				
May 12	S. G. Bennett	23	36.0	Flume No. 13, main canal below head of Oakdale Canal.
Do	do		73.0	Flume No. 6, main canal below head of Oakdale Canal.
Do	do		13.71	

Discharge measurements of Stanislaus Water Company's Canal, Stanislaus River, near Knights Ferry, Stanislaus County.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1896.		*Feet.*	*Sec.-feet.*	
Sept. 8	H. Crowe		66	
Oct. 30	J. B. Lippincott		38	
1897.				
Feb. 16	J. B. Lippincott		26	Below forks.
Do	do		13	Little John Canal.
	Total		39	
May 30	J. B. Lippincott		54	Main canal below forks.
Do	do		12	Little John Canal.
	Total		66	
July 13	A. Q. Campbell		36	Below forks.
Do	do		15	Little John Canal.
	Total		51	
Sept. 6	A. Q. Campbell		52	Below forks.
Do	do		1	Little John Canal.
	Total		53	
Oct. 29	A. Q. Campbell		35	Below forks.
Do	do		1	Little John Canal.
	Total		36	
Dec. 19	J. B. Lippincott		17	Below forks.
Do	do		4	Little John Canal.
	Total		21	

Discharge measurements of Stanislaus Water Company's Canal, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1898.		*Feet.*	*Sec.-feet.*	
Apr. 17	J. B. Lippincott		58	
June 1	do		72	Main canal flume No. 3.
July 29	do		42	Do.
Oct. 5	do		33	
Oct. 6	do		33	
1899.				
May 19	S. G. Bennett		74	Do.
June 6	do		71	Do.
1900.				
May 9	S. G. Bennett	2.79	95	Do.
Sept. 7	do		85	At headworks of canal.
1902.				
May 12	S. G. Bennett	1.14	129	Flume No. 3, main canal.
Aug. 16	E. T. Perkins		3.5	San Antonio Creek below mouth of Big Tree Creek.
Aug. 17	do		67	Angel's ditch near head North Fork Stanislaus.
Do	do		1	North Fork, 400 feet below suspension bridge.
	Total		68	
Aug. 17	E. T. Perkins		2.3	Mill Creek at junction Love and Morgan creeks.
Aug. 20	do		54	Power company's flume above ditch tender's house, South Fork.
Do	do		16	Do.
Aug. 21	do		53	Clarks Fork at mouth Middle Fork.
Do	do		126	Middle Fork below mouth of Clarks Fork.
Do	do		73	Middle Fork above mouth of Clarks Fork.
Aug. 14	do		53	Standard ditch at flume No. 59.
Aug. 22	L. M. Lawson		193	Below Colliers.
Aug. 24	do		170	Abbotts ferry.
Aug. 21	do	.6	168	Parrotts ferry.
Aug. 23	do		171	Robinsons ferry.
Aug. 19	do		166	Knights ferry.
Aug. 17	do		154	Stanislaus Water Co.'s canal below intake.

Discharge measurements of Stanislaus Water Company's Canal, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Remarks.
1900.		*Feet.*	*Sec.-feet.*	
Sept. 7	S. G. Bennett		[a] 28	At headworks Stanislaus Water Co.'s Canal, 6 miles above Knights Ferry.
Sept. 7	do		[b] 85	
	Total		113	

[a] River. [b] Canal.

Discharge measurements of Stanislaus River, Tuolumne County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
1896.		*Feet.*	*Sec.-feet.*	
Sept. 3	J. B. Lippincott		60	South Fork at Sugar Pine. In flume; not entire flow of river.
1901.				
Sept. 17	C. E. Moore		300	Middle Fork, 15 miles above junction with North Fork.

STONY CREEK.

This stream drains 700 square miles of the eastern slopes of the Coast Range. After reaching the Sacramento Valley it flows north for a number of miles, contrary to the general drainage, and then turns eastward and enters the Sacramento River 20 miles below Vina, Cal. A large portion of the basin near the heads of the stream is heavily covered with commercial timber. There are a number of good reservoir sites on this stream and its tributaries.

On January 30, 1901, a gaging station was established by Mr. Burt Cole at Julian's ranch, 6 miles northwest of the town of Fruto, Cal., to determine the amount of water available for storage.

For a description in detail of the reservoir sites and drainage basin of Stony Creek, see Water-Supply and Irrigation Paper No. 86.

Discharge measurements of Stony Creek, Glenn County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
		Feet.	*Sec.-feet.*	
Aug., 1900[a]	Burt Cole		0.0	Grindstone Creek, 4 miles above mouth.
Sept., 1900[a]				
Oct., 1900[a]				
Nov. 22, 1901	H. E. Green		38.0	Grindstone Creek, point above bridge.
Aug. 3, 1900	Burt Cole		1.7	Hall ditch.
Sept. 30, 1900	do		1.4	Hall ditch, 100 feet above head gate.
July 28, 1900	do		2.3	Orland ditch.
Aug. 3, 1900	do		1.7	Do.
Sept. 30, 1900	do		1.3	Do.
Sept. 22, 1900	S. G. Bennett		7.7	1 mile below Elk Creek.
Aug., 1900[a]	Burt Cole		.0	Briscoe Creek, at mouth.
Sept., 1900[a]				
Oct., 1900[a]				
Nov. 22, 1901	H. E. Green		10.4	Briscoe Creek, above dam site.
Sept. 21, 1900	Burt Cole		13.8	Brown ditch.
Sept. 1, 1899	W. W. Brier		3.25	Thomas Creek, Tehama County, at Richfield Station.
Nov. 11, 1900	Burt Cole		62.0	Gaging station, Julian's ranch.
Feb. 19, 1901	do		18,000.0[b]	
Feb. 27, 1901	do	6.9	2,583.0	Do.
Mar. 9, 1901	do	5.6	933.0	Do.
Apr. 30, 1901	S. G. Bennett	4.9	382.0	Do.
Sept. 3, 1901	do	3.17	3.4	Do.
Nov. 21, 1901	H. E. Green	4.3	165.0	Do.
Jan. 26, 1902	S. G. Bennett	3.9	126.0	Do.
Feb. 28, 1902	do	10.0	7,336.0	Do.
May 8, 1902	S. G. Bennett	5.33	1,080.0	Do.
Sept. 24, 1902	do	3.00	14.0	Do.
Sept. 21, 1900	B. Cole		.3	Laux ditch.
Do	do		20.0	Stony Creek, near Stony Fork, above Laux ditch.
Sept. 26, 1900	do		6.2	Stony Ford ditch, at headgate.
Sept. 21, 1900	do		.3	Welton ditch headgate.

[a] Dry. [b] Estimated.

Estimated monthly discharge of Stony Creek at Julian's ranch.

[Drainage area, 760 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
February	10,385	725	2,707	150,339	3.56	3.71
March	2,215	435	893	54,908	1.18	1.36
April	630	225	361	21,481	.48	.54
May	555	225	349	21,459	.46	.53
June	195	5	66	3,927	.09	.10
July	15	0	7	430	.01	.01
August	10	2	4	246	.01	.01
September	725	5	35	2,083	.05	.06
October	340	0	130	7,993	.17	.20
November	1,125	35	161	9,580	.21	.23
December	3,875	77	425	26,132	.56	.64
11 months	10,385	0	428	298,578	.57	7.39
1902.						
January	150	109	114	7,010	0.15	0.17
February	14,650	109	4,201	233,312	5.53	5.76
March	7,000	920	2,588	159,130	3.41	3.93
April	4,680	690	1,522	90,565	2.00	2.23
May	1,000	270	578	35,540	.76	.88
June	370	5	132	7,855	.17	.19
July	9	2	3	184	0	0
August	5	2	3	184	0	0
September	14	5	9	536	.01	.01
October	225	55	92	5,657	.12	.14
November	5,005	109	1,584	94,255	2.08	2.32
December	2,765	690	1,132	69,604	1.49	1.72
The year	14,650	2	997	703,832	1.31	17.35

SUSAN RIVER.

Discharge measurements of Susan River at Honey Lake Basin, Lassen County.

Date.	Hydrographer.	Gage height.	Discharge.	Locality.
1899.		*Feet.*	*Sec.-feet.*	
Apr. 18	Albert Halen		25.0	Mouth of Willow Creek.
Apr. 18	W. D. Minckler		25.0	Do.
Apr. 23	Albert Halen		28.0	Do.
June 4	do		25.0	Do.
Apr. 24	W. D. Minckler		28.0	Willow Creek, near Ravencrofts.
June 4	do		24.0	Do.
June 11	Albert Halen		21.0	Do.
June 11	W. D. Minckler		21.0	Do.
1900.				
June 4	L. H. Taylor	2.60	16.0	Do.
July 30	do	2.85	26.0	Do.
Oct. 10	do	2.80	20.0	Do.
1899.				
Apr. 18	Albert Halen		139.0	Main river, dam near mouth of Willow Creek.
Apr. 23	do		115.0	Do.
June 4	do		37.0	Do.
June 11	do		33.0	Do.
June 11	do		34.0	Main river, below dam.
Apr. 18	W. D. Minckler		14.5	Do.
Apr. 23	do		41.0	Do.
June 11	do		34.0	Main river, below Colony dam.
	do		23.0	Do.
1900.				
June 30	L. H. Taylor	3.20	40.0	Near Susanville.
July 5	do	2.60	8.0	Do.
1901.				
Mar. 16	do	4.30	274.0	Do.
Apr. 5	do	4.00	178.0	Do.
May 20	do	4.50	351.0	Do.
June 7	do	3.60	84.0	Do.

Discharge measurements of Susan River at Honey Lake Basin, etc.—Continued.

Date	Hydrographer.	Discharge.	Locality.
1899.		*Sec.-feet.*	
June 11	W. D. Minckler	33.00	North and South branches above Colony dam.
Apr. 24	do	31.00	South Branch, Otis Johnson's.
June 4	do	30.00	Do.
Apr. 4	do	11.00	North Branch, Otis Johnson's.
June 4	do	7.00	Do.
Apr. 18	do	30.00	Tanners Slough.
Apr. 23	do	27.00	Do.
June 4	do	15.00	Do.
June 11	do	18.00	Do.

SUTTER RIVER.

Discharge measurement of Sutter River, Amador County.

Date.	Hydrographer.	Discharge.	Locality.
1899.		*Sec.-feet.*	
Sept. 18	S. G. Bennett	1.00	At Sutter Creek (estimated).

SWEETWATER RIVER.

The drainage basin of Sweetwater River is in the extreme southwestern corner of the United States, being in San Diego County, Cal., adjacent to the Republic of Mexico. The river flows from the western slope of Cuyamaca Mountain, which rises to an elevation of 6,000 feet. The city of San Diego, on the coast, is about 33 miles west and 12 miles south of this peak. The drainage basin is 34 miles in length by about 5 miles in width, its total area above the reservoir being 186 square miles, as determined in part from survey and in part from the county maps. This area is classified as follows:

	Sq. miles.
Steep and rocky mountains favorable to large run-off	26
Lower rolling mountains, usually covered with brush	99
Rolling hills, covered with soil and disintegrated granite	30
Agricultural lands (17 per cent) and river bottom	31
Total	186

The most noticeable topographic feature of this basin influencing the run-off is the abrupt flattening of the slopes at the base of the mountains into agricultural fields. The drainage lines deeply cut into the steep hillsides are quickly lost or are poorly defined in crossing the flat

alluvial cones or partly filled valleys on the low grounds. In turn, the nearly level fields or parks drain into deep canyons. The occasional flood caused by a heavy rain rushing down the mountain side spreads out over the flat lands, much of it disappearing before it can reach the lower canyon. The steady percolation which might be expected at points below is to a large extent cut off by the high rate of evaporation, and thus the percentage of run-off, taking the basin as a whole, is small. A more detailed description of this river is given in William Ham. Hall's report on irrigation in southern California.

The figures relating to the amount of water draining from this basin and also the other details given in the following table have been compiled from data obtained by Mr. H. N. Savage, chief engineer, and Mr. James D. Schuyler, consulting engineer, of the San Diego Land and Town Company. The first column in the table gives the evaporation from the surface of the Sweetwater reservoir in inches in depth per month. This was measured from a metallic pan exposed to the direct rays of the sun at a point near the dam, this being continued in use until May, 1893. Subsequently observations were made by means of a Piche evaporometer.[a] This was placed in an instrument shelter of the ordinary type used by the Weather Bureau. This shelter is 15 feet above the ground and about 40 feet above the level of the lake, being located 500 feet northeast from the gate tower. It has been noted that the records from the Piche evaporometer which cover the same months as those from the pan are in the ratio of 48 to 57. It is believed that the exposed pan gives more nearly the evaporation from the water surface than the Piche evaporometer. If the evaporation were annually 5 feet in depth from the surface of the reservoir—that is, from the 70-foot level down to the 65-foot level—the loss would amount to 24 per cent of the total amount stored. The area of the reservoir at the 70-foot level is 721.86 acres.

The average wind velocity given in miles per hour is that noted at the city of San Diego, 12 miles from the reservoir, and under similar conditions. In this connection it may be well to note the results obtained by Prof. Thomas Russell as to the effect of velocity upon evaporation obtained by whirling the Piche evaporometer at varying rates.

Experiments were made which show that the effect of the wind on the evaporation from a vessel exposed in the open air is very great. Two Piche instruments were taken, one suspended in quiet air and the other fixed rigidly on the end of the 28-foot arm of the whirling machine set up in the inclosure of the Pension Office building. The whirling machine was the one used in standardizing anemometer.

The instruments, filled with water, were first weighed on a fine balance to the hundredth of a gram. The whirling arm was then turned so that the Piche on its end moved with a velocity of 5 miles an hour. The motion was continued for

[a] Described by Prof. Thomas Russell in the Monthly Weather Review for September, 1888, in connection with a report upon the depth of evaporation in the United States.

half an hour, and at the end of the time both Piches were again weighed. Then the Piche that had been suspended in quiet air was put on the arm, and the one that had been on the arm was put in its place. The whirling was then started again at the same velocity, and continued for another half hour. At the end of the time the Piches were again weighed. While this was being done the humidity of the air was determined from time to time by means of whirled wet and dry bulb thermometers.

Observations were also made in the same way with the Piche moving at velocities of 10, 15, 20, 25, and 30 miles per hour. At a velocity of 5 miles an hour the evaporation from a Piche was 2.2 times that from one in quiet air; at 10 miles, 3.8 times; at 15 miles, 4.9 times; at 20 miles, 5.7 times; at 25 miles, 6.1 times; and at 30 miles, 6.3 times. During the time the observations were made, June 25 and 26, 1888, the average temperature of the air was 83.7 and the relative humidity 50 per cent.

Measurements were made of the relative humidity at the reservoir during 1893 and 1894. When not obtained at this point they are given from the Weather Bureau figures for San Diego. The temperature of the air is taken as the average of the maximum and minimum daily readings. The temperature of the water in the lake and also in the pan was taken daily. That in the pan was observed at about 2 p. m., thus giving a reading slightly higher than that of the lake, as the pan under the hot sun caused the water to warm slightly. If two readings had been taken each day at intervals of twelve hours the average would probably have been very nearly that of the lake. It is noted that the water in the lake was usually a few degrees warmer than the atmosphere.

RAINFALL IN SWEETWATER BASIN.

The rainfall has been measured at two rain gages, one at the reservoir and one at Descanso, 25 miles east of the reservoir and at an elevation of 3,500 feet. The Descanso gage is 3 miles to the east of the summit of a ridge which may act in such a manner as to cut off the precipitation, thus reducing it below a theoretical amount for this position. In addition to the two rain gages within the drainage basin, the record from a third—that at the Cuayamaca reservoir—is given. This is at an elevation of 4,800 feet, and is only 3 miles distant from the divide between the drainage of Sweetwater and of San Diego River. The gage here is in a narrow valley or canyon, and the results obtained, being probably influenced by local topography, are regarded as excessive for this altitude and the locality. The rainfall at the dam in the winter of 1900–1901 was 11 inches.

The total amount of precipitation, as obtained at the reservoir and at Descanso, is not considered as showing the rainfall upon the drainage basin as a whole. One of the gages is located too high and the other too low to fairly represent the average conditions. In order, therefore, to obtain approximately the total amount of water falling upon the basin, certain assumptions are made and corrections are

applied to the recorded precipitation. It is assumed that there is a regular increase in the rate of precipitation with altitude, and that this is at the rate of 0.6 inch of rain for each 100 feet increase in elevation. It is also assumed that the mean elevation of the whole basin is approximately 2,200 feet. Taking San Diego, which is nearly at sea level, as the base station, this, under the assumptions just given, would indicate that the rainfall on the basin should average 13.2 inches greater than that at San Diego. As the average rainfall at San Diego is 9.92 inches, the rainfall on the Sweetwater catchment area should be 9.92 plus 13.2 inches, or 23.12 inches.

In the same way the average rainfall is deduced from the measurements at the points within the basin. At Descanso the average rainfall is 26.38 inches. This point, having an altitude of 3,500 feet, is 1,300 feet above the assumed altitude of Sweetwater basin. Deducting, therefore, 7.8 inches leaves 18.58 inches as the average rainfall. Again, taking the results obtained at the rain gage at the Sweetwater reservoir, 12.01 inches, at an elevation of 250 feet, and adding to this the theoretical increase due to altitude of 11.70 inches, the sum 23.71 can be applied to the basin. The average of these two computations, based on the observations at Descanso and at the reservoir, is 21.14 inches for the basin. This method has been used in the following table, page 351, in determining the average rainfall throughout the 186 square miles in the catchment basin for each year, additions being made to the rainfall recorded at the reservoir, and subtractions from that at Descanso, the average of the two results thus obtained being given in the table.

RUN-OFF FROM SWEETWATER BASIN.

The discharge from this watershed, embracing 186 square miles, during the winter of 1900–1901, was 280,000,000 gallons, or 861 acre-feet.

The run-off shown in the table on page 351 has been computed by Mr. H. N. Savage. The stream usually ceased flowing about the 1st of June and remained dry throughout the summer, water flowing again in the fall or early winter after the rains began. At this latter time the reservoir is at a low stage, the water having been used for irrigation during the hot season. The flow into the reservoir, being wholly held, is therefore computed from the increase of height shown by the readings on the gage rod in the reservoir, due allowance being made for evaporation and the amount withdrawn. Later, when the reservoir is full and some of the water overflows, an additional amount must be added. To obtain this amount is a somewhat difficult matter, as the water flows out through a gate valve, over the waste weir, and also occasionally, during floods, over the top of the dam.

Evaporation, temperature, and rainfall at Sweetwater reservoir, San Diego County.

Month.	Evaporation.	Wind (miles per hour).	Humidity.	Temperature.		Rainfall.		
				Air, degrees Fahrenheit.	Water, degrees Fahrenheit.	At reservoir.	At Descanso.	At Cuyamaca.
1888.	*Inches.*		*Per cent.*			*Inches.*	*Inches.*	*Inches.*
September	.....	.....	.....	70	.....	0.00	.....	0.21
October	.....	.....	.....	65	.....	.36	.....	3.82
November	.....	.....	.....	60	.....	2.81	.....	8.33
December	.....	.....	.....	58	.....	3.20	.....	13.30
1889.								
January	1.990	4.8	80	57	.....	1.56	.....	2.99
February	3.336	5.7	74	56	.....	.82	.....	4.70
March	3.380	5.4	80	59	.....	3.87	.....	12.85
April	4.961	5.6	79	61	.....	.36	.....	3.34
May	5.822	5.9	75	61	.....	.21	.....	2.21
June	6.806	5.5	81	64	.....	.33	.....	.00
July	7.398	5.1	79	67	.....	.01	.....	.00
August	8.253	5.0	69	73	.....	.00	.....	1.71
September	7.360	5.1	.....	71	.....	.00	.....	.03
October	2.998	4.7	.....	65	.....	2.22	.....	2.82
November	4.800	4.4	.....	60	.....	1.08	.....	1.64
December	.246	4.7	.....	56	.....	7.07	.....	21.00
1890.								
January	1.588	5.0	.....	48	.....	2.20	.....	11.02
February	2.214	5.2	.....	52	.....	2.07	.....	16.36
March	3.280	4.9	.....	55	.....	1.30	.....	4.00
April	4.141	5.1	.....	58	.....	.10	.....	.97
May	6.140	4.6	.....	60	.....	.41	.....	.00
June	7.302	5.4	.....	65	.....	.00	.....	.00
July	7.380	4.7	.....	70	.....	.00	.....	.09
August	9.020	4.6	.....	71	.....	.07	.....	.90
September	6.482	4.3	69	72	.....	.42	.....	1.40
October	4.920	4.0	79	66	.....	.45	.....	.58
November	5.535	4.3	59	65	.....	.93	.....	3.62
December	1.845	4.5	83	62	.....	2.29	.....	12.13
1891.								
January	3.608	4.4	58	55	.....	.83	.....	.00
February	1.353	5.8	73	52	.....	5.28	.....	34.70
March	3.075	5.3	74	57	.....	.23	.....	3.17
April	3.707	4.9	76	58	70	1.27	.....	3.50

Evaporation, temperature, and rainfall at Sweetwater reservoir, etc.—Continued.

Month.	Evaporation.	Wind (miles per hour).	Humidity.	Temperature.		Rainfall.		
				Air, degrees Fahrenheit.	Water, degrees Fahrenheit.	At reservoir.	At Descanso.	At Cuyamaca.
1891.	*Inches.*		*Per cent.*			*Inches.*	*Inches.*	*Inches.*
May	5.599	5.4	75	61	69	0.83	.....	3.69
June	6.027	4.6	74	65	78	.09	.....	.00
July	6.501	4.0	78	71	80	.00	.....	.04
August	8.890	3.8	77	73	82	.03	.....	.30
September	6.150	4.7	76	73	76	.00	.....	2.67
October	6.314	3.8	79	66	72	.00	.....	.00
November	4.100	3.8	74	60	64	.13	.....	.45
December	2.752	5.4	65	52	54	.90	.....	6.75
1892.								
January	2.542	3.7	58	55	54	2.42	.....	7.23
February	1.394	4.7	75	54	63	3.47	.....	6.47
March	3.075	4.8	73	56	66	.55	.....	7.76
April	5.822	5.5	82	57	70	.93	.....	3.35
May	4.674	5.7	68	61	71	1.39	.....	5.90
June	6.478	5.6	69	63	74	.07	.....	.67
July	8.808	5.0	73	67	78	.00	.....	.00
August	6.540	4.9	74	68	78	.02	.....	.00
September	6.273	4.8	74	68	76	.00	0.00	.00
October	6.560	4.2	65	64	[a]68	.15	.00	.30
November	4.766	3.7	50	62	60	.04	1.50	2.87
December	2.614	4.3	66	53	56	2.12	2.00	3.76
1893.								
January	2.768	4.0	51	57	58	.22	3.01	5.55
February	2.214	5.1	67	54	59	1.96	2.64	9.13
March	1.076	6.2	76	51	60	6.50	14.07	15.60
April	5.002	5.3	73	58	64	.27	.50	1.00
May	4.902	5.8	72	61	68	.20	.00	1.00
June	3.411	4.9	77	65	76	.00	.00	.00
July	5.318	5.1	77	69	81	.16	.75	1.20
August	4.693	5.0	75	72	80	.00	.00	.30
September	4.864	5.1	75	66	77	.00	.25	.00
October	4.586	4.6	67	65	70	.33	1.25	1.90
November	4.513	4.5	65	58	60	.84	3.15	3.30
December	6.283	4.5	60	58	58	2.08	4.38	6.05

[a] End of measurements from pan and beginning of observations on Piche evaporometer.

Evaporation, temperature, and rainfall at Sweetwater reservoir, etc.—Continued.

Month.	Evaporation.	Wind (miles per hour).	Humidity.	Temperature.		Rainfall.		
				Air, degrees Fahrenheit.	Water, degrees Fahrenheit.	At reservoir.	At Descanso.	At Cuyamaca.
1894.	*Inches.*		*Per cent.*			*Inches.*	*Inches.*	*Inches.*
January	3.897	5.0	68	50	52	0.36	2.10	2.05
February	3.533	5.2	67	50	56	.71	3.40	2.05
March	3.008	5.8	73	56	59	1.69	3.63	3.00
April	3.634	5.4	70	59	65	.04	.13	.00
May	3.451	5.7	74	59	68	.15	.50	1.00
June	4.683	5.6	72	62	76	.00	.38	.50
July	3.161	5.2	75	67	80	.00	.12	.00
August	3.066	4.8	77	68	82	.00	.13	1.50
September	4.637	5.1	76	69	75	.00	.00	.40
October	3.232	3.8	72	64	70	.04	.00	.00
November	3.347	3.9	76	59	64	.00	.00	.00
December	2.344	4.3	73	54	59	3.03	7.62	12.76
1895.								
January	2.357	6.0	74	53	.....	9.63	19.52	28.43
February	2.850	5.0	.....	54	.....	1.52	2.76	6.05
March	3.121	5.3	.....	56	.....	1.18	3.13	5.52
April	3.939	5.2	.....	58	.....	.44	.64	1.20
May	4.119	5.8	77	63	.....	.35	.63	.16
June	3.188	.....	.....	66	.....	.00	.00	.00
July	[a] 6.428	.....	.....	69	.....	.00	.00	.00
August	[a] 6.744	.....	.....	71	.....	.00	.00	.00

[a] Estimated.

The following table gives, for the period from 1888 to 1901, the estimated precipitation upon the catchment basin, obtained as stated on page 347, also the depth of run-off in inches and the relation which this bears to the depth of rainfall, by years. The years chosen are not calendar years, but extend from September to August, inclusive, as this division is more in accordance with the distribution of rainfall and the discharge of the streams.

Estimated rainfall upon the Sweetwater catchment basin; also depth and percentage of run-off.

Year.	Rain.	Run-off.		Per cent.
		Per square mile.	Inches.	
	Inches.	*Sec.-feet.*		
1887–88		0.0524		
1888–89	21.00	.1875	2.54	12.000
1889–90	25.71	.1525	3.71	14.000
1890–91	23.40	.1602	2.07	9.000
1891–92	17.14	.0460	.62	4.000
1892–93	20.00	.1210	1.61	8.000
1893–94	14.76	.0099	.14	1.000
1894–95	27.14	.5452	7.12	26.000
1895–96	19.54	.0098	.101	.517
1896–97	24.91	.0512	.665	2.67
1897–98	18.18	.00003	.0005	.003
1898–99	18.51	.0018	.025	.135
1899–1900	19.10	0	0	0
1900–1901	23.65	.0063	.087	.368
1901–1902	20.29	0	0	0

The figures showing evaporation, wind movement, humidity, and temperature are brought together for comparison by years in the following table. In this case, as stated above, the years extend from September to August, inclusive, as this most nearly agrees with the natural division.

Annual evaporation, temperature, etc., in Sweetwater Basin.

[Elevation of reservoir, 250 feet.]

Period.	Evaporation.	Wind.	Humidity.	Temperature of air.	Temperature of water.
	Inches.	*Miles per hour.*	*Per cent.*	*Deg. F.*	*Deg. F.*
1888–89	.....	.....	.....	.....	.....
1889–90	56.47	4.9	.....	.....	.....
1890–91	57.54	4.6	.....	.....	.....
1891–92	58.65	4.8	72	61	68
1892–93	49.60	4.9	68	61	67
1893–94	48.68	5.1	70	60	67
1894–95	46.31	5.2	79	59	.....
1895–96	45.18	5.2	71	61	.....
1896–97	[a] 41.24	5.3	76	61	.....
1897–98	61.93	5.9	73	60	.....
1898–99	[b] 32.54	5.8	72	59	.....
1899–1900	.....	5.7	75	61	.....
1900–1901	.....	.....	.....	62	.....

[a] Evaporation January 1 to August 31. [b] Evaporation September 1 to April 30.

FLOODS IN THE RIVER.

The Sweetwater, like the other rivers of southern California, is liable at times to extraordinary floods, due to heavy precipitation upon the catchment basin. In 1893 two floods furnished 70 per cent of the annual discharge of the river for that year. For the 24 hours ending March 24, 1893, the river discharged 3,069 acre-feet. For the seven days ending March 27, the total amount discharged was 7,980 acre-feet. In January, 1895, a flood was carefully watched and the flow computed at short intervals, as shown in the following table. The total run-off from 5 p. m. on January 14 to noon on January 22 was equivalent to a trifle over 4.70 inches over the whole drainage basin, or in all 46,670 acre-feet. This same storm gave a maximum discharge from Cedar, Boulder, and Colman creeks, aggregating 100 square miles within the drainage basin of San Diego River, of 13,000 second-feet.

Rate of flow during flood of January, 1895, in Sweetwater River.

Time.	Second-feet.
January 14:	
5 p. m	0
January 15:	
7 a. m	84
12 m	1,855
3 p. m	6,410
4 p. m	5,214
5 p. m	5,262
6 p. m	4,152
7 p. m	6,135
9 p. m	5,567
10 p. m	5,080
January 16:	
5 a. m	3,297
6 a. m	4,720
7 a. m	3,585
8.30 a. m	5,316
9.30 a. m	5,370
10.30 a. m	6,602
11.30 a. m	8,713
12.30 p. m	8,713
1.30 p. m	13,684
2 p. m	13,000
2.30 p. m	15,148
3.30 p. m	18,148
4 p. m	14,034
4.30 p. m	14,490
5.30 p. m	7,227
6.30 p. m	9,420
7.30 p. m	8,310
8 p. m	6,930
January 17:	
5 a. m	5,302
6 a. m	3,545
8 a. m	3,954
January 17—Continued.	
3 p. m	4,416
January 18:	
8 a. m	3,331
9 a. m	2,090
10 a. m	2,048
7 p. m	2,466
January 19:	
5 a. m	1,532
8.30 a. m	2,944
9.30 a. m	2,888
10.30 a. m	3,068
11.30 a. m	3,470
1.30 p. m	3,364
3 p. m	3,968
3.30 p. m	4,692
4 p. m	3,224
4.30 p. m	3,230
9 p. m	3,176
January 20:	
7 a. m	3,314
9 a. m	2,805
10 a. m	2,674
11 a. m	2,484
1 p. m	2,500
2 p. m	2,136
January 21:	
7 a. m	1,880
10 a. m	820
12 m	750
5.30 p. m	800
January 22:	
7 a. m	810
12 m	530

INCREASE OF PRECIPITATION WITH ALTITUDE.

In connection with the above data concerning the rainfall and run-off on the Sweetwater drainage basin, the writer has given a discussion of the precipitation in southern California, and has brought

together figures showing the increase of rainfall with altitude. The following statement is quoted from a report made on this subject:

The warm, moisture-laden winds from the sea on their inland journey are driven up the slopes in the Coast Range. As they rise in elevation they expand under the lighter atmospheric pressure, become chilled, and are deprived of all moisture in excess of the point of saturation at that temperature and pressure. This lowering of temperature in their ascent is more pronounced in winter than in summer, and, coupled with the fact that a high barometer is normal off the coast of southern California during the summer season, the winds yield much less rain.

The year in California is naturally divided into a wet and a dry season, the dry season beginning about the 1st of May, with little rain falling, except in thunderstorms in the high mountains, before the 1st of October. The rains then gradually increase, reaching their maximum in January. The records of the United States Signal Service and the Weather Bureau begin the year with the 1st of January. This is not a proper division in this region, as it will not show either the maximum or minimum years of rainfall. Engineers divide the year either with the 1st of July or the 1st of September.

The effect of topography on rainfall is given in a report by Prof. G. E. Curtis[a] in the following words:

"In general the amount of rain increases with the elevation above sea level up to a maximum plane, after which a decrease takes place. S. A. Hill has shown that in the northwest Himalayas, where the rainfall is most remarkable in amount and rate of variation, the observations can be represented by the following empirical formula: $R=1+1.92h-0.40h^2+0.02h^3$, in which R represents the amount of rain and h the relative height in units of 1,000 feet above the assumed plane, which is itself 1,000 feet above sea level. From this formula the height of maximum rainfall is computed to be 3,160 feet above the plane, or 4,160 feet above sea level. It is further shown that this elevation is that at which, according to the observed law of decrease of temperature, the southwest monsoon is cooled just below its dew-point. This point will be that at which in the mean we should expect the maximum precipitation to take place. * * * A very rapid diminution takes place on the leeward side, where the stations record only about half the amount of rainfall given by stations of equal elevation on the windward side."

Similar conditions prevail in California. In illustration the following table (p. 355) is given, in which the results obtained at a base station are compared with those from other stations in the vicinity and on that parallel. The base station in each case is one whose record is of long standing. In the table the second column gives the period during which the record has been kept. The third shows the elevation of the station above sea. The fourth gives the annual average recorded rain at that station. The fifth gives the relation of the rainfall at the base station during the years that rainfalls were actually recorded at the station under consideration, to the total average rainfall recorded at the base station during its entire period of observation. The record at the second station is then adjusted by this ratio and a probable average rainfall is determined for the station considered and entered in the sixth column under the head "Probable mean rain."[b] For example, take the station Poway. The record at this point is for ten years, while the record at the base station, San Diego, has been kept for a period of

[a] Signal Service Notes, No. 16 The effect of wind currents on rainfall, by G. E. Curtis, Washington, 1884, pamphlet, 11 pp., pp. 6-7.

[b] See statement of Arthur Jacobs, late executive engineer for irrigation, Her Majesty's Bombay Service, in Van Nostrand's Science Series, No. 6, p. 11.

orty-five years. Now, the average annual rain for a period of forty-five years is probably nearer the actual average than that given by a record extending over a much less period. The two stations, being so near together and subject to the same general climatic conditions, have probably a close relation. If during the time that the record has been kept at Poway the rain at San Diego is found to be 117 per cent of the average of forty-five years, then the recorded rain at Poway is assumed to be 117 per cent of the average there.

By examining the data available, it has been found that the increase in precipitation due to elevation is approximately at the rate of 0.6 of an inch of rain for each 100 feet rise in elevation on the western slope of the Coast Range and of the Sierra Nevadas in California. There is also an increase due to elevation on the eastern slope, but this is very much less in amount. The figures in the seventh column in the table below have been obtained by adding the computed increase due to elevation above the base station to the recorded rain at the base station. By comparing these figures in the seventh column, showing theoretical rainfall, with the recorded mean rainfall and the probable mean rainfall given in the fourth and sixth columns, the applicability of this deduced rate of increase of precipitation with altitude is shown.

Table showing the relation of rainfall to elevation in California.

Station.	Period.	Elevation.	Rainfall.			
			Recorded.	Per cent.	Probable mean.	Theoretical.
First group.		*Feet.*	*Inches.*		*Inches.*	*Inches.*
San Diego [a]	1850–95	0	9.92			
Sweetwater, reservoir	1888–95	250	12.37	103	12.01	11.42
Poway	1878–89	460	13.38	117	11.43	12.68
Descanso	1889–95	3,500	26.65	101	26.38	30.92
Julian	1879–84	4,500	37.75	130	29.04	36.92
Cuyamaca	1887–95	4,800	44.66	102	43.79	38.72
Second group.						
Los Angeles [a]	1871–94	330	16.96			
Bear Valley, reservoir	1883–94	6,000	54.03	110	49.09	50.92
Third group.						
Sacramento [a]	1849–89	31	19.90			
Auburn	1870–84	1,360	32.72	102	32.08	27.78
Colfax	1870–84	2,422	44.81	102	43.93	34.20
Cisco	1870–84	5,934	57.41	102	56.28	55.20
Summit	1870–84	7,017	47.93	102	46.99	61.80
Fourth group.						
Truckee	1870–84	5,919	29.53	102	28.95	54.60
Reno	1870–91	4,497	5.17	102	5.07	46.56
Wadsworth	1870–91	4,085	3.83	102	3.75	44.28

[a] Base stations.

The stations of the first and second groups are located in San Diego County, and are all on the western slope of the Coast Range. Bear Valley is 80 miles east of Los Angeles on the same slope. The third group comprises the stations along the Central Pacific from Sacramento east to the summit, and the fourth those along the same line of road on the eastern slope 14, 49, and 83 miles by rail beyond the summit. This fourth group is given to show that wholly different conditions prevail on the eastern and on the western slope of the mountain.

All these records are seasonal, the year being divided at the 1st of September when possible. Data are given from Signal Service and Weather Bureau reports, and from those of the California State engineer, the former being accepted in cases of difference. Excepting the fourth or last group, which is given simply to show that the conditions prevailing on the eastern slope are different from those of the western, it may be seen that the theoretical rain is very nearly the same as the probable mean rain. The instances where the widest variations exist usually can be explained.

In regard to the value of the theoretical rainfall, reference may again be made to the paper by Professor Curtis. He states (p. 8) that the Signal Service, in an investigation of the rainfall on the summit of Mount Washington to determine the local distribution and the average rainfall for the station, placed five gages on the summit of the mountain, one in the center and four to the four points of the compass 75 feet distant from it. It has been known for a long time that a gage placed at an elevation above ground usually recorded less than one placed on the ground below, this difference being caused by wind currents. The increased velocities of the wind around the corners and over the tops of the buildings, hills, or even the gage, tend to increase the slant of the falling rain at those points, and when just past the obstruction, the velocity of the wind being again reduced, a heavier fall of rain will be deposited. In this experiment on Mount Washington observations were made from September 1, 1882, to October 1, 1883. As the measurement of snow was reported as altogether unreliable, it was excluded. In the following table it is shown that the windward gages had received during this period 24.64 inches of rain and the leeward ones 28.43 inches, single storms showing greater variation. The conclusion reached is that precipitation varies materially within distances of only 100 or 200 feet.

The most remarkable feature of the experiment is the different results obtained from gages with 3-inch and 8-inch catchment cups. The gages that were set to the four points of the compass had 3-inch cups and the regular station gage had one 8-inch cup. For the period in question the four exterior gages recorded 45.82, 51.19, 45.40, and 42.63 inches, respectively, while the regular station gage recorded 58.70 inches of rain.

Comparative reading of 3-inch and 8-inch gages in wind.

	Wind velocity in miles per hour.							
	15		40		60		75	
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Diameter of gage	3	8	3	8	3	8	3	8
Amount of rain	1.75	1.84	2.77	3.37	1.60	2.44	1.87	3.49
Per cent	100	105	100	122	100	152	100	186

In view of these records, which are taken with experimental care, the statement would be justified that the "Probable rainfall," as shown in the table on page 351, agrees with the "Theoretical rainfall" as closely as it can be measured, the gages being of different makes and sizes.

The recorded rainfall of the Cuyamaca gage is probably in excess of the average rain for this elevation and the locality, and it is so considered by engineers in San Diego. The gage is in a narrow valley or canyon, and is probably affected by the winds and the topography.

It will be seen that Cisco, with an elevation of 5,934 feet, has a rainfall of 56.28 inches, while Summit, 13 miles beyond, with an elevation of 7,017, has only 46.99 inches of rain. It may be that this variation is due to the wind action, especially on the snow, which averages each year 31 feet in depth, or to the fact that Summit is above the plane of maximum rainfall, as mentioned on page 354.

TECOLOTE CREEK.

Discharge measurement of Tecolote Creek, Santa Barbara County.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
Aug. —	G. F. Wright	[a] 0.27

[a] Drainage area, 2 square miles.

TEJON CREEK.

See Fort Tejon Creek.

TEJON HOUSE CREEK.

Discharge measurements of Tejon House Creek, at Tejon Ranch House, Kern County.

Date.	Hydrographer.	Discharge.
1895.		*Sec.-feet.*
Mar. 6	J. B. Lippincott	22.7
Apr. 3	do	17.2
Sept. 4	A. P. Davis and J. B. Lippincott	1.57
Nov. 13	J. B. Lippincott	3.46
1896.		
Feb. 1	J. B. Lippincott	7.82
Feb. 2	do	18.3
June 4	do	6.09
June 5	do	8.31
Dec. 18	do	3.96
Dec. 19	do	2.66

TEMESCAL CREEK.

Discharge measurements of Temescal Creek at lower pipe line, Temescal Land and Water Company, Temescal, Riverside County, Cal.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
Jan. 28	F. Rolfe	0.66
Feb. 1	do	0.00
Feb. 11	do	.31
Feb. 15	do	1.39
Feb. 20	do	1.56
Mar. 4	do	4.22
Mar. 12	do	3.55
Mar. 18	do	2.69
Mar. 25	do	2.91
Mar. 31	do	3.42
Apr. 14	do	.89
Apr. 22	do	2.28
Apr. 29	do	2.28
May 6	do	4.46
May 13	do	2.55
May 30	do	3.08
June 9	do	3.10
June 15	do	2.36
July 4	do	2.87
July 19	do	2.03
July 25	do	2.49
Aug. 5	do	1.12
Aug. 11	do	2.40
Aug. 21	do	2.65

Discharge measurements of Temescal Creek at upper pipe line, Temescal Land and Water Company, Temescal, Riverside County.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
Jan. 4	S. G. Dennett	0.99
Jan. 27	F. Rolfe	.74
Feb. 4	do	1.62
Feb. 11	do	.87
Feb. 18	do	3.67
Feb. 24	do	3.37
Mar. 3	do	3.87
Mar. 12	do	5.10
Mar. 16	do	3.56
Mar. 25	do	3.74
Mar. 31	do	4.16
Apr. 14	do	2.93
Apr. 22	do	3.71
Apr. 29	do	3.22
May 6	do	2.80
May 13	do	4.02
May 18	do	4.21
May 30	do	4.01
June 9	do	3.36
June 16	do	3.52
July 10	do	3.21
July 19	do	3.20
July 25	do	3.67
Aug. 11	do	1.48
Aug. 11	do	4.26
Aug. 21	do	3.84

Discharge measurements of Evans ditch, Temescal Creek, Temescal, Riverside County.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
July 1		3.75
August		3.00

TORO CANYON.

Discharge measurement of Toro Canyon, Santa Barbara County.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
June 16	J. B. Lippincott	0.05

TRABUCO CREEK.

Discharge measurement of Trabuco Creek, Orange County.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
May 24	F. Rolfe	[a] 1.08

[a] Ditch near San Juan Capistrano.

TRUCKEE RIVER.

TRUCKEE RIVER AT TAHOE, CAL.

Truckee River, the natural outlet of Lake Tahoe, leaves the lake at the city of Tahoe. About 500 feet from the lake there is a timber dam across the river, which has been maintained for more than twenty years for the purpose of controlling the discharge from the lake. During the early part of the year 1900 the gates in this dam were kept closed, not being opened until June 17, when a gage was placed in the stream for the purpose of recording the height of the water in the river. The gage is a vertical timber driven into the stream bed at the left bank, about 300 feet below the dam, and is spiked to the root of a tree growing on the bank. The bench mark is cut in the side of the tree, and is 4 feet above gage datum. The measurements are made from a cable and suspended car about one-fourth of a mile below the gage, which was placed as near the city of Tahoe as possible for the convenience of the observer. At the point of measurement the right bank is low, and is subject to overflow at very high stages of the stream, but the left bank is rather high. The channel is nearly straight for a short distance above and below the station, and the bed of the river, which is of gravel and coarse sand, is smooth and stable. The purpose of the station is to ascertain the actual outflow from Lake Tahoe, with a view to determining its value as a storage reservoir.

Discharge measurements of Truckee River at outlet of Lake Tahoe, Placer County.

Date.	Hydrographer.	Discharge.
1899.		*Sec.-feet.*
July 9		136
Aug. 8		75
Aug. 14		56
Aug. 18		49

Discharge measurements of Truckee River at Tahoe, Placer County.

Date.	Hydrographer.	Gage height.	Discharge.
1900.		*Feet.*	*Sec.-feet.*
June 18	L. H. Taylor	0.75	92
June 30	do	1.45	2.40
July 12	do	1.60	2.77
Sept. 7	do	1.40	225
Oct. 23	do	.40	52
Oct. 23	do	.95	130
Oct. 23	do	1.15	158
1901.			
Sept. 5	C. V. Taylor	1.94	386
Sept. 12	do	1.85	356
Nov. 11	do	1.57	296
Nov. 11	do	1.23	187
Nov. 11	do	1.00	141
1902.			
Oct. 22	E. C. Murphy		320

Discharge measurements of Truckee River one-half mile below Truckee.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
June 3		364
June 12		264

Estimated monthly discharge of Truckee River at Tahoe.

[Drainage area, 519 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
July	1,185	442	914	56,200	1.76	1.90
August	441	393	425	26,111	.82	.94
September	392	357	374	22,244	.72	.80
October	496	344	415	25,538	.80	.92
November	471	408	437	26,002	.84	.94
December	253	246	250	15,388	.48	.56
1896.						
January	293	244	262	16,102	.50	.58
February	292	288	290	16,677	.56	.60
1900.						
March	----------	----------	0	0	0	0
April	----------	----------	0	0	0	0
May	----------	----------	0	0	0	0
June	236	0	52	3,106	.10	.11
July	260	0	214	13,131	.41	.47
August	260	211	232	14,261	.45	.53
September	224	177	196	11,667	.38	.43
October	177	155	159	9,781	.31	.36
November	200	0	135	8,047	.26	.29
December	99	0	81	4,981	.16	.18
1901.						
January	117	85	102	6,262	.20	.23
February	117	30	81	4,502	.16	.16
March	30	30	30	1,845	.06	.07
April	30	0	9	565	.02	.02
May	0	0	0	0	0	0
June	178	0	30	1,765	.06	.06
July	293	156	225	13,809	.43	.50
August	555	293	419	25,760	.81	.93
September	390	117	326	19,395	.63	.70
October	308	251	282	17,308	.54	.63
November	293	189	247	14,678	.48	.53
December	189	100	111	6,841	.21	.25
The year	555	0	155	112,730	.30	4.08

Discharge measurements of tributaries of Truckee River at various points.

DEER CREEK, PLACER COUNTY.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
June 16		25.2

SQUAW CREEK, PLACER COUNTY.

1900.		
June 5		81.4
June 16		46.0
Sept. 14		2.76

DONNER CREEK, NEAR DONNER LAKE.

1900.		
May 16		127.8
May 29		73.4
July 13		1.09
Aug. 20		69.0
Sept. 13		19.2

DONNER CREEK, NEAR TRUCKEE RIVER.

1900.		
May 21		324.5
June 3		127.0
June 12		98.9
July 13		14.7
1902.		
Oct. 22	E. C. Murphy	3.25

COLD CREEK, NEVADA COUNTY.

1900.		
Sept. 13		1.35

Discharge measurements of tributaries of Truckee River, etc.—Continued.

MARTIS CREEK.

Date	Hydrographer.	Discharge.
1889.		*Sec.-feet.*
June 1		19
June 22		7
1900.		
May 21		24.51
June 4		17.52
Sept. 14		8.54

JUNIPER CREEK AT CLINTON.

1889.		
May 30		22
1900.		
June 6		[a] 30
Sept. 15		1.33

JOE GRAY CREEK AT ICELAND.

1889.		
May 31		88
1900.		
May 19		30
July 28		20.28
Sept. 15		12.28

ALDER CREEK AT FLORISTON.

1889.		
May 31		42
1900.		
May 19		[a] 30
July 25		12.63
Sept. 10		10.29

[a] Estimated.

Discharge measurements of tributaries of Truckee River, etc.—Continued.

DOG VALLEY CREEK AT VERDI.

Date.	Hydrographer.	Discharge.
1889.		*Sec.-feet.*
May 22		7
1900.		
July 26		.40
Sept. 10		.79
1902.		
Oct. 7	D. W. Hays	7.14

TRUCKEE RIVER AT ESSEX, WASHOE COUNTY, NEV.

1889.		
May 20		2,330
May 21		2,570
May 22		2,510
May 29		1,716
June 20		350

SQUAW CREEK ABOUT HALFWAY FROM LAKE TAHOE.

1889.		
June 3		92
June 5		81.4
June 16		46
June 22		15
Sept. 14		2.76

CREEK NEAR TAHOE TOLLGATE.

1889.		
June 3		74

DONNER CREEK.

1889.		
July 3		8
July 6		5
July 11		2
July 16		1
Aug. 7		.9
Aug. 10		.2
Aug. 17		.3

Discharge measurements of tributaries of Truckee River, etc.—Continued.

COLD CREEK THREE-QUARTERS OF A MILE BELOW DONNER LAKE.

Date.	Hydrographer.	Discharge.
1889.		*Sec.-feet.*
June 28		11
July 3		10
July 6		5
July 11		1
Aug. 7		1
Aug. 10		1
Aug. 17		.7

PROSSER CREEK.

1900.		
June 4		[a] 145
July 27		[a] 25
Sept. 9		[a] 9.54
1902.		
Oct. 23	E. C. Murphy	[b] 21.24

LITTLE TRUCKEE RIVER AT BOCA.

1900.		
May 19		[c] 600
June 6		492
Aug. 16		8.94
Sept. 15		27.14

HUNTER CREEK.

1900.		
June 7		40.7
Sept. 12		5.93

INDEPENDENCE CREEK AT INDEPENDENCE LAKE.

1902.		
Oct. 24	E. C. Murphy	.27

[a] At mouth. [b] At Prosser. [c] Approximate.

Discharge measurements of streams flowing into Lake Tahoe.

WARD CREEK.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
Iay 5	.....	147

BLACKWOOD CREEK.

1900.		
Iay 6	.....	140

THREE SMALL STREAMS BETWEEN IDLEWILD AND MCKINNEY'S.

1900.		
Iay 6	.....	[a] 12

M'KINNEY CREEK.

1900.		
May 6	.....	150

GENERAL CREEK.

1900.		
May 7	.....	100

MEIGGS CREEK.

1900.		
May 7	.....	130

FIVE SMALL STREAMS BETWEEN MEEKS CREEK AND EMERALD BAY.

1900.		
May 7–8	.....	[a] 12

EMERALD BAY CREEK.

1900.		
May 8	.....	60

[a] Estimated.

Discharge measurements of streams flowing into Lake Tahoe—Continued.

CASCADE CREEK.

Date.	Hydrographer.	Discharge.
1900.		*Sec.-feet.*
May 8	.....	30

TAYLOR CREEK.

1900.		
May 8	.....	160

UPPER TRUCKEE RIVER.

1900.		
May 9	.....	350

TEN SMALL STREAMS BETWEEN BIJOU AND GLEN BROOK IN NEVADA.

1900.		
May 10	.....	[a]15

[a] Estimated.

TRUCKEE RIVER AT NEVADA-CALIFORNIA STATE LINE.

This river has its source on the slopes of the Sierra Nevada in eastern California and flows northward, entering Lake Tahoe. This lake is at an elevation of 6,225 feet, and is the largest body of fresh water in the United States at this considerable altitude. The area of the lake itself is 193 square miles. As the State line between Nevada and California passes through the lake, a portion of it is in each State. The outlet of the lake is at Tahoe, Cal., and Truckee River from this point has a general northward course, receiving a number of important tributaries which contribute to its flow. There are a number of lakes at the headwaters of the branch stream, which have been surveyed and recommended as reservoir sites. The drainage area is mapped on the Pyramid Peak, Truckee, Carson, and Markleeville atlas sheets of the United States Geological Survey. The basin is now partially included in the Lake Tahoe forest reserve, set apart by Executive proclamation of April 13, 1899. September 7, 1899, a station was established on this river by L. H. Taylor, at the State line, 17 miles west of Reno, Nev. The gage is vertical, driven into the bed of the river and wired to a granite bowlder. The bench mark

is the top of the rock to which the rod is fastened, and is at an elevation of 10 feet above gage datum. The channel is straight for a short distance above and below the station. The banks are not liable to overflow. The bed of the river is of gravel and cobbles and is quite stable.

Discharge measurements of Truckee River at State line.

Date.	Hydrographer.	Gage height.	Discharge.
1899.		*Feet.*	*Sec.-feet.*
Sept. 7	L. H. Taylor	2.0	303
1900.			
Apr. 10	L. H. Taylor	2.9	753
May 15	do	4.1	1,493
May 22	do	4.3	1,629
June 1	do	3.7	1,112
June 15	do	3.2	901
July 1	do	2.5	534
July 14	do	2.5	551
Sept. 6	do	2.3	447
Oct. 2	do	1.9	318
1901.			
Feb. 13	C. V. Taylor	1.5	298
Feb. 27	do	4.5	2,474
Mar. 11	do	3.4	1,262
June 9	do	3.9	1,741
July 13	do	2.6	811
Aug. 16	do	2.1	528
Sept. 3	do	2.2	570
Sept. 14	do	2.0	478
Nov. 9	do	1.95	437
Dec. 14	do	1.75	353
1902.			
Apr. 10	C. V. Taylor		1,492
May 10	do		2,384

Estimated monthly discharge of Truckee River at Nevada-California State line.

[Drainage area, 955 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
September 17–30	363	295	303	18,030	0.32	0.36
October	632	295	354	21,767	.37	.43
November	1,566	295	581	34,572	.61	.68
December	328	264	295	18,139	.31	.36
1900.						
January	897	295	392	24,103	0.41	0.47
February	363	264	318	17,661	.33	.34
March	1,131	295	797	49,006	.83	.96
April	1,409	735	902	53,673	.94	1.05
May	1,885	1,196	1,528	93,953	1.60	1.84
June	1,409	328	950	56,529	.99	1.10
July	533	401	459	28,223	.48	.55
August	486	328	396	24,349	.41	.47
September	486	205	367	21,838	.38	.42
October	897	234	481	29,575	.50	.58
November	897	328	480	28,562	.50	.56
December	1,131	205	407	25,025	.43	.50
The year	1,885	205	623	452,497	.65	8.80

TRUCKEE RIVER AT VISTA, NEV.

On the lower courses of this river there are considerable stretches of irrigable land which, however, have not yet been developed to their fullest extent. The drainage basin is peculiar in that its mountainous collecting area is located in the State of California, while the lands which can be irrigated are situated in Nevada. This may lead in the future to certain legal difficulties, but not to the extent that it would if there were agricultural lands in both States. Truckee River, after entering Nevada, flows in a general easterly and then northerly direction, emptying into Pyramid Lake. The drainage area is mapped on the Pyramid Peak, Truckee, Markleeville, Carson, Reno, and Wadsworth atlas sheets of the United States Geological Survey. The station at Vista, Nev., was established August 18, 1899, by L. H. Taylor, and is located 7 miles east of Reno. The rod is spiked to posts driven into the bed of the river. The bench mark is on a bluff of rock 500 feet east of the gage, and is at an elevation of 17.50 feet

above gage datum. A new bench mark was established March 14, 1901, on the top of a 2 by 2 inch plug driven 2 feet into the ground at the upper end of the inclined gage on the left bank. Its elevation is 9.60 feet above the datum of the gage. Both banks are high and not liable to overflow. The bed is rocky and not subject to change.

Discharge measurements of Truckee River at Vista, Nev.

[L. H. Taylor, hydrographer.]

Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*
September 5	2.0	105
October 28	2.75	477
1900.		
April 25	3.30	7.57
May 14	3.80	9.89
May 23	4.30	1,326
June 9	3.80	967
June 14	4.10	1,150
June 19	2.90	471
June 28	2.70	372
July 2	2.20	207
July 10	2.05	138
July 24	2.00	99
August 22	2.30	198
September 28	2.25	226
1901.		
February 22	6.35	3,077
March 14	3.85	[a] 899
March 20	3.88	[a] 911
June 21	4.10	1,165
July 12	2.70	417
August 15	2.20	198
September 2	2.50	325
September 14	2.40	276
November 13	3.05	584
December 15	2.78	448

[a] Results too small.

Estimated monthly discharge of Truckee River at Vista, Nev.

[Drainage area 1,519 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1890.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
April			4,496			
May			5,990			
June			4,162			
July			2,198			
August			952			
September			682			
October			742			
November			765			
December			750			
1891.						
January			[a] 700			
February			[a] 650			
March			[a] 650			
April			1,523			
May			2,765			
June			1,905			
July			945			
August			485			
September			558			
October			561			
November			503			
December			508			
The year			980			
1892.						
January			593			
February			505			
March			723			
April			854			
May			937			

[a] Estimated.

Estimated monthly discharge of Truckee River at Vista, Nev.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
August 18–31	----------	----------	114	----------	----------	----------
September	188	74	152	9,073	0.10	0.11
October	1,066	144	378	23,251	.25	.29
November	1,123	355	516	30,713	.34	.38
December	709	331	456	28,019	.30	.35
1900.						
January	1,210	380	479	29,445	0.32	0.36
February	529	380	426	23,671	.28	.29
March	1,094	454	857	52,668	.56	.65
April	1,239	479	756	44,982	.50	.56
May	1,477	843	1,257	77,289	.83	.95
June	1,239	259	709	42,201	.47	.52
July	307	74	110	6,746	.07	.08
August	283	61	122	7,513	.08	.09
September	283	105	192	11,449	.13	.14
October	1,123	258	430	26,456	.28	.33
November	1,298	331	566	33,660	.37	.42
December	1,268	429	554	34,049	.36	.42
The year	1,477	61	538	390,129	.35	4.81
1901.						
January	1,505	418	661	40,644	0.44	0.50
February	4,213	418	1,486	82,529	.98	1.02
March	2,209	938	1,328	81,657	.87	1.01
April	1,942	747	1,380	82,117	.91	1.01
May	4,213	1,410	2,145	131,894	1.42	1.63
June	1,942	854	1,263	75,155	.83	.93
July	995	146	425	26,133	.28	.32
August	492	128	315	19,369	.21	.23
September	467	251	329	19,577	.22	.24
October	720	370	477	29,330	.31	.36
November	882	467	557	33,144	.37	.41
December	1,287	322	510	31,357	.34	.39
The year	4,213	128	906	652,906	.60	8.05

TULE RIVER.

Tule River drains a portion of the western slope of the Sierra Nevada. Its watershed is somewhat less productive of run-off than that of Kaweah River, which joins it on the north, and much less elevated and snow covered than Kings River basin.

The waters of this stream are all appropriated during the irrigation season, and a portion of them are used in irrigating valuable orange lands in the vicinity of Porterville, Cal.

The gaging station is located about 8 miles east of Porterville, at a point just below the wagon bridge near the McFarland ranch, and about 1 mile above the mouth of the South Fork of Tule River. The station was established April 18, 1901. The gage rod is situated on the right bank of the river, 100 feet below the bridge. The zero of the gage is 8 feet below a spike driven into a large cottonwood tree. The area of the watershed above the gaging station is approximately 300 square miles.

Discharge measurements of Tule River.

Date.	Hydrographer.	Discharge.	Location.
		Sec.-feet.	
Nov. 18, 1895	J. B. Lippincott	32.1	In Pioneer canal.
Nov. 18, 1895	do	28.4	River below canal.
	Total	60.5	
Sept. 2, 1900	S. G. Bennett	4.3	Canal.
Sept. 2, 1900	do	4.7	River.
	Total	9.0	
Oct. 3, 1902	L. M. Lawson	7.0	Canal.
Oct. 3, 1902	do	8.2	River.
	Total	15.2	
Oct. 3, 1902	L. M. Lawson	14.0	At headworks, Pioneer canal.
Oct. 3, 1902	do	7.0	1 mile below intake, Pioneer canal.
July 19, 1901	A. E. Chandler	19.8	Below intake of Pioneer canal
Oct. 3, 1902	L. M. Lawson	8.2	
May 23, 1901	W. N. Frickstad	152.0	Rockford Bridge, 6 miles west of Porterville.
June 28, 1901	A. E. Chandler	164.6	14 miles above Porterville.

Discharge measurements of Tule River, Tulare County.

Date.	Hydrographer.	Discharge.	Location.
1902.		*Sec.-feet.*	
Sept. 30	E. T. Perkins	2.6	Middle Fork, trail crossing below location of Doyle's headworks.
Sept. 30	do	14.0	Middle Fork 100 yards above head Doyles ditch.
Oct. 1	do	24.0	Middle Fork at trail crossing near junction with East Fork.
Oct. 1	do	15.0	East Fork 100 yards above mouth.
Oct. 3	do	10.0	East Fork at trail crossing Nelsons to Indian Reservation.
Oct. 2	do	3.0	South Fork 6 miles below Indian Agency.
Oct. 3	do	3.2	South Fork near Tom Wheaton's ranch.
Oct. 3	L. M. Lawson	([a])	South Fork at junction of North Fork.
Oct. 3	do	4.0	Pioneer canal at Porterville.

[a] Dry.

Discharge measurements of Tule River at McFarlands Bridge, above mouth of South Fork.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Apr. 18	S. G. Bennett	2.5	233
May 22	J. B. Lippincott	2.85	338
June 10	do	2.65	311
June 28	A. E. Chandler	2.00	148
July 29	S. G. Bennett	1.23	30
Oct. 18	do	1.00	18
Dec. 9	do	1.44	58
1902.			
Feb. 5	do	1.33	43
Mar. 8	do	2.2	156
May 15	do	3.03	371
Oct. 2	L. M. Lawson	.92	15

Discharge measurements of Lower Tule canal at Tulare Lake.

Date.	Hydrographer.	Discharge.
1901.		*Sec.-feet.*
June 24	A. E. Chandler	198.2

Discharge measurements of Pioneer canal, Tulare County.

Date.	Hydrographer.	Discharge.	Location.
1898.		*Sec.-feet.*	
Sept. 1	P. M. Baier	6.0	
1899.			
Sept. 5	S. G. Bennett	13.1	200 feet below headworks.
Sept. 5	do	8.43	1 mile below headworks.
Sept. 5	do	7.06	2 miles below headworks.
1902.			
Oct. 3	L. M. Lawson	14.0	At headworks.
Oct. 3	do	7.0	1 mile below headworks.

Discharge measurements of South Fork of Tule River at mouth, 7 miles east of Porterville, Tulare County.

Date.	Hydrographer.	Discharge.
1901.		*Sec.-feet.*
June 10	J. B. Lippincott	47.3
July 29	S. G. Bennett	[a] .5
1902.		
May 15	do	103.0

[a] Estimated.

Estimated monthly discharge of Tule River at Porterville.[a]

[Drainage area, 437 square miles.]

Month.	Discharge.			Total discharge	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November			131	7,795	0.30	0.33
December			131	8,055	.30	.35
1879.						
January			57	3,505	0.13	0.15
February			87	4,832	.20	.21
March			61	3,751	.14	.16
April			118	7,021	.27	.30
May			105	6,456	.24	.28
June			350	20,826	.80	.89
July			35	2,152	.08	.09
August			26	1,599	.06	.07
September			26	1,547	.06	.07
October			74	4,550	.17	.20
November			140	8,330	.32	.36
December			271	16,663	.62	.71
The year			113	81,232	.25	3.49
1880.						
January			577	35,478	1.32	1.52
February			1,040	59,821	2.38	2.57
March			1,079	66,344	2.47	2.84
April			1,289	76,701	2.95	3.28
May			1,040	63,946	2.38	2.75
June			721	42,902	1.65	1.84
July			350	21,520	.80	.92
August			87	5,349	.20	.23
September			44	2,618	.10	.11
October			44	2,705	.10	.12
November			87	5,177	.20	.22
December			219	13,466	.50	.58
The year			548	396,027	1.25	16.98

[a] Authority, California State engineering department from November, 1878, to October, 1884.

Estimated monthly discharge of Tule River at Porterville—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1881.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			219	13,466	0.50	0.58
February			437	24,270	1.00	1.04
March			437	26,870	1.00	1.15
April			874	52,006	2.00	2.25
May			874	53,740	2.00	2.31
June			437	26,003	1.00	1.12
July			219	13,466	.50	.58
August			175	10,760	.40	.46
September			87	5,177	.20	.22
October			66	4,058	.15	.17
November			57	3,392	.13	.1[illegible]
December			66	4,058	.15	.17
The year			329	237,266	.75	10.1[illegible]
1882.						
January			87	5,349	0.20	0.2[illegible]
February			109	6,053	.25	.2[illegible]
March			306	18,815	.70	.8[illegible]
April			660	39,273	1.51	1.6[illegible]
May			1,748	107,480	4.00	4.6[illegible]
June			660	39,273	1.51	1.6[illegible]
July			437	26,870	1.00	1.1[illegible]
August			131	8,055	.30	.3[illegible]
September			66	3,927	.15	.1[illegible]
October			44	2,705	.10	.1[illegible]
November			66	3,927	.15	.1[illegible]
December			66	4,058	.15	.1[illegible]
The year			365	265,785	.83	11.[illegible]

Estimated monthly discharge of Tule River at Porterville—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1883.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			87	5,349	0.20	0.23
February			87	4,832	.20	.21
March			437	26,870	1.00	1.15
April			656	39,034	1.50	1.67
May			874	53,740	2.00	2.31
June			874	52,006	2.00	2.23
July			350	21,521	.80	.92
August			87	5,349	.20	.23
September			66	3,927	.15	.17
October			44	2,705	.10	.12
November			44	2,618	.10	.11
December			66	4,058	.15	.17
The year			306	222,009	.70	9.52
1884.						
January			262	16,109	0.60	0.69
February			1,748	100,546	4.00	4.31
March			1,311	80,610	3.00	3.46
April			874	52,006	2.00	2.23
May			2,185	134,350	5.00	5.76
June			3,059	182,023	7.00	7.81
July			2,622	161,220	6.00	6.92
August			874	53,740	2.00	2.31
September			350	20,826	.80	.89
October			175	10,760	.40	.46

Estimated monthly discharge of Tule River at McFarlands Bridge near Porterville, Tulare County.

[Drainage area, 437 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet*	*Sec.-feet.*
May	875	298	418	25,702	0.96	1.10
June	408	126	240	14,281	.55	.61
July	126	30	61	3,751	.14	.16
August	30	18	19	1,168	.04	.04
September	23	10	17	1,012	.04	.04
October	109	18	29	1,783	.07	.08
November	71	35	43	2,559	.10	.11
December	64	39	50	3,074	.11	.13
1902.						
January	51	34	45	2,767	.10	.12
February	1,415	45	159	8,830	.36	.37
March	2,735	144	362	22,259	.83	.95
April	4,615	249	571	33,977	1.31	1.46
May	408	273	343	21,090	.79	.91
June	324	78	190	11,306	.43	.48
July	78	26	43	2,644	.10	.12
August	33	18	21	1,291	.05	.06
September	17	14	15	893	.03	.03
October	93	14	24	1,476	.05	.06
November	144	27	50	2,975	.11	.12
December	204	45	62	3,812	.14	.16
The year	4,615	14	157	113,320	.36	4.84

TUMITUS CREEK.

Discharge measurement of Tumitus Creek, San Mateo County.

Date.	Hydrographer.	Discharge.
1893.		*Sec.-feet.*
Oct. 17	W. W. Brier	*a* 1.14

TUNIS CREEK.

Discharge measurement of Tunis Creek, Kern County.

Date.	Hydrographer.	Discharge.
1896.		*Sec.-feet.*
June 4	J. B. Lippincott	1.98
Dec. 15	do	.7

[a] At mouth.

TUOLUMNE RIVER.

HETCH HETCHY DAM SITE, HETCH HETCHY VALLEY.

The entire drainage of Tuolumne River above Lagrange is about 1,500 square miles, some 400 square miles of which lie above the Hetch Hetchy dam site, the elevation of which is 3,630 feet above sea level. This upper drainage area consists of high granite mountains culminating in Mount Dana, Mount Gibbs, and Mount Lyell.

A gaging station was established at this point May 30, 1901, by J. B. Lippincott, for the city of San Francisco.

For detailed description of Hetch Hetchy reservoir site see Twenty-first Annual Report of U. S. Geological Survey, Part IV, page 450.

Discharge measurements of Tuolumne River, Hetch Hetchy Valley, Tuolumne County.

Date.	Hydrographer.	Gage height.	Discharge.	Location.
1899.		*Feet.*	*Sec.-feet.*	
July 31	H. Ramel		238.0	
Aug. 5	do		230.0	
Aug. 12	do		131.0	
Aug. 19	do		101.0	
Aug. 23	do		69.0	
1901.				
Aug. 13	J. B. Lippincott and W. W. Cockins, jr.		472.0	Ford in Hetch Hetchy Valley.
Aug. 29	W. W. Cockins, jr	12.93	190.5	Do.
Sept. 5	do	12.65	155.7	Do.
Sept. 14	do	12.42	77.5	Do.
Oct. 5	do	12.92	115.6	Do.
Oct. 11	do	12.60	88.0	Do.
Aug. 25	do	13.28	231.3	1,000 feet above dam site.
Sept. 28	do	13.11	144.7	Do.
1902.				
Aug. 29	E. T. Perkins		66.0	Upper end Hetch Hetchy Valley.

Discharge measurements of Tuolumne River at Hetch Hetchy dam site.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
June 29	C. A. Miller and W. W. Cockins, jr	36.00	7,621.00
July 4	C. A. Miller	30.00	3,296.00
July 12	do	26.10	2,720.00
July 21	do	24.17	1,886.00
July 29	W. W. Cockins, jr	21.50	1,160.00
Aug. 2	do	20.33	1,137.00
Aug. 13	J. B. Lippincott	15.70	754.00
Sept. 20	W. W. Cockins, jr	12.32	66.12

Discharge measurements of Tuolumne River at old bridge above Rancheria Creek, Tuolumne County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
July 13	C. A. Miller		1,849
Aug. 26	W. W. Cockins, jr		160
Sept. 28	do		120
Oct. 11	do		60

Discharge measurements of Rancheria Creek (tributary to Tuolumne River) at old sheep bridge, Tuolumne County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Aug. 26	W. W. Cockins, jr		36.2
1902.			
Aug. 29	E. T. Perkins		[a] 7.0

[a] At head of falls.

CHERRY RIVER AT ELEANOR TRAIL CROSSING.

Cherry River is a tributary of the Tuolumne and enters that stream 12½ miles below Hetch Hetchy Valley. The area drained is 130 square miles.

A gaging station was established at the point where Eleanor trail crosses the river, on May 26, 1901, by J. B. Lippincott, for the city of San Francisco.

Discharge measurements of Cherry Creek, a tributary of Tuolumne River, at Eleanor trail crossing.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
July 8	C. A. Miller	11.40	915.0
July 17	do	10.40	510.0
Aug. 9	W. W. Cockins, jr	8.75	112.0
Aug. 19	do	9.10	132.0
Aug. 20	do	8.40	107.0
Aug. 24	do	8.10	43.0
Sept. 1	do	7.80	17.5
Sept. 7	do	7.70	6.1
Sept. 17	do	7.00	4.3
Sept. 22	do	7.06	4.5
Sept. 26	do	9.05	141.0
Oct. 3	do	8.96	120.0
Oct. 10	do	8.00	43.0
1902.			
Aug. 30	E. T. Perkins		[a] 4.4
Aug. 30	do		6.0

[a] 1,500 feet below trail crossing.

ELEANOR CREEK AT ELEANOR TRAIL CROSSING.

Eleanor Creek is a tributary of Cherry River and enters that stream 6 miles above its mouth. The elevation of the outlet of Lake Eleanor is 4,655 feet above sea level. The drainage area above the gaging station is 81 square miles, and consists of high granite mountains culminating in Richardson Peak, elevation 9,845 feet; Haystack Peak, elevation 9,966 feet; and an unnamed peak, elevation 10,510 feet. The average elevation of the drainage basin is probably 7,500 feet.

A gaging station was established at the outlet of Lake Eleanor June 1, 1901, by J. B. Lippincott, for the city of San Francisco.

For a detailed description of Lake Eleanor reservoir site see Thirteenth Annual Report of the U. S. Geological Survey, Part III, page 402.

Discharge measurements of Eleanor Creek at inlet to Lake Eleanor, Tuolumne County.

Date	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
June 11	C. A. Miller		[a] 226.0
Do	do		[b] 74.0
	Total		300.0
July 16	C. A. Miller		[a] 121.0
Do	do		[b] 23.0
	Total		144.0
Aug. 18	W. W. Cockins, jr		[a] 75.0
Do	do		[b] 11.6
	Total		86.6
Aug. 27	W. W. Cockins, jr		[a] 8.3
Do	do		[b] 1.5
	Total		9.8
Oct. 1	W. W. Cockins, jr		[a] 47.6
Do	do		[b] 7.4
	Total		55.0

[a] West Branch. [b] East Branch.

Discharge measurements of Eleanor Creek at outlet of Lake Eleanor, Tuolumne County.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec. feet.*
June 10	C. A. Miller	8.67	411.0
June 22	do	9.76	793.0
July 8	J. B. Lippincott	8.57	310.0
July 16	C. A. Miller	7.92	263.0
July 18	do	7.80	225.0
July 27	W. W. Cockins, jr	7.45	145.0
Aug. 3	do	7.10	84.0
Aug. 10	do	6.92	75.0
Aug. 17	do	6.48	30.0
Aug. 19	do	6.68	42.0
Aug. 23	do	6.47	32.0
Aug. 27	do	6.26	17.8
Aug. 30	do	6.05	13.9

Discharge measurements of Eleanor Creek, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-feet.*
Sept. 6	W. W. Cockins, jr	5.90	6.22
Sept. 14	do	5.70	4.08
Sept. 21	do	5.72	5.02
Sept. 26	do	5.85	5.77
Oct. 3	do	6.40	34.5
Oct. 10	do	6.21	21.2

Discharge measurements of Tuolumne River.

Date.	Hydrographer.	Discharge.	Location.
1902.		*Sec.-feet.*	
Aug. 22	E. T. Perkins	6.0	North Fork at headworks, Goldwin Mining Co.'s canal.
Aug. 27	do	152.0	⅛ mile above junction of South Fork.
Do	do	20.0	South Fork, ⅛ mile above junction of main river.
Aug. 29	do	.5	Tiltill Creek at trail crossing.
Do	do	89.0	Lower end Hetch Hetchy Valley.
Aug. 31	do	3.0	100 yards below bridge, Middle Fork.
Sept. 2	do	23.0	Above falls, lower end Tuolumne Meadows.
Aug. 25	do	22.0	Jacksonville.
Aug. 26	do	159.0	Ward's ferry.
Aug. 28	L. M. Lawson	150.0	Jacksonville, Tuolumne County.
Aug. 27	do	4.0	Mining Company's ditch at Lagrange, Stanislaus County.
Do	do	105.0	Turlock canal.

Discharge measurements of Frog Creek at inlet Eleanor Lake, Tuolumne County, Cal.

Date.	Hydrographer.	Discharge.	Location.
1901.		*Sec.-feet.*	
June 12	C. A. Miller	116.0	
July 17	do	33.	
Aug. 18	W. W, Cockins, jr	5.7	
Aug. 27	do	1.0	
Oct. 1	do	4.9	

Discharge measurements of Falls Creek at Lake Vernon (upper end), Tuolumne County, Cal.

Date.	Hydrographer.	Discharge.	Location.
1901.		*Sec.-feet.*	
Aug. 12	J. B. Lippincott	36.5	
Sept. 5	W. W. Cockins, jr.	9.8	Tiltill trail crossing.
Sept. 19	do	3.0	Do.
Oct. 4	do	16.0	Do.
1902.			
Aug. 29	E. T. Perkins	4.0	100 yards above junction with Tuolumne.

TUOLUMNE RIVER AT LAGRANGE.

This river rises on the western slope of the Sierra Nevada in California and drains the country located between Stanislaus River on the north and Merced River on the South. The northern half of the Yosemite National Park includes a portion of its drainage basin. The river is fed largely from small mountain lakes occurring high in the drainage basin, where snow remains on the mountain slopes throughout the year. The stream has a heavy fall, and the opportunities for power development are numerous. There are also a number of reservoir sites in the basin where water could be stored during the irrigation season. The gaging station, established August 29, 1895, is located at the wagon bridge in the town of Lagrange, Cal. The rod is vertical and is bolted to the right-hand pier of the bridge. The bench mark is a nail driven into the bottom of the west post of the fifth bent south of the south iron cylinder, and is 15.31 feet above gage datum. The station is located below the high dam of the Turlock and Modesto irrigation districts, and also below the head of the canal of the Lagrange Hydraulic Mining Company. This latter canal diverts water from the left bank of the river 14 miles above Lagrange dam. This water is used for hydraulic mining, and partly returns above the gaging station, depending on the convenience of the miners. During 1898 water was first turned down the Turlock Canal in small quantity, and was used for puddling the banks and testing dams of certain reservoirs. Whenever measurements at the gaging station were made, the Turlock Canal and the mining company's canal were also measured. The channel at the station, both above and below the bridge, is straight for several hundred feet, and the velocity of the stream is rather uniform. Both banks are high and not subject to overflow.

Discharge measurements of Tuolumne River at Lagrange, Stanislaus County.

Date.	Hydrographer.	Gage height.	Discharge.
1895.		*Feet.*	*Sec.-feet.*
Aug. 29	J. B. Lippincott	4.4	299.00
Sept. 14	do	5.8	1,824.00
Nov. 28	do	4.2	129.00
1896.			
Apr. 15	J. A. Vogleson	6.95	4,236.00
May 4	H. Crowe	7.0	4,004.00
June 17	do	9.3	8,274.00
Sept. 4	do	4.9	671.00
Oct. 30	J. B. Lippincott	4.45	361.00
1897.			
Feb. 15	do	5.8	1,864.00
May 29	do	9.25	11,594.00
July 12	A. Q. Campbell	5.7	1,839.00
Sept. 7	do	4.0	95.00
Oct. 30	do	4.73	534.00
Dec. 20	J. B. Lippincott	4.85	614.00
1898.			
May 31	do	5.9	1,887.00
Apr. 18	do	7.18	5,762.00
July 30	do	3.95	103.00
Oct. 7	do	4.2	[a] 30.00 [b] 24.00 [c] 83.00
	Total		137.00
1899.			
Mar. 3	J. B. Lippincott	5.0	774.00
Apr. 20	S. G. Bennett	7.55	5,712.00
Apr. 21	do	7.85	6,943.00
May 19	do	6.72	3,616.00
June 6	do	8.47	8,964.00
June 29	do	6.15	2,347.00
Aug. 3	do	3.70	23.00
Sept. 11	do	3.58	[c] 12.00 [a] 29.00 [b] 24.00
	Total		65.00

[a] Turlock Canal. [b] La Grange Ditch and Hydraulic Mining Company's Canal. [c] River.

Discharge measurements of Tuolumne River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
1900.			
April 5	S. G. Bennett	6.08	[a]2,286.00 [b]129.00 [c]24.00
	Total		2,439.00
May 20	S. G. Bennett	8.4	8,720.00
June 22	do	7.09	[c]4,629.00 [a]9.50 [b]12.50
	Total		4,651.00
Aug. 11	S. G. Bennett		[c]17.00 [a]117.00 [b]12.00
	Total		146.00
Sept. 8	S. G. Bennett		[a]35.00 [b]9.05 [c]10.90
	Total		54.95
Dec. 27	S. G. Bennett	5.32	964.00
1901.			
Jan. 29	S. G. Bennett	5.75	1,419.00
Apr. 7	do	6.10	[c]2,382.00 [b]7.00
	Total		2,389.00
June 12	J. B. Lippincott	7.63	6,470.00
Aug. 2	S. G. Bennett	5.45	1,354.00
Aug. 31	do	4.30	248.00
1902.			
May 6	S. G. Bennett	6.00	[c]2,351.00 [a]103.00 [b]5.00
	Total		2,459.00

[a] Downey Turlock Canal. [b] La Grange Ditch and Hydraulic Mining Company's canal.

Discharge measurements of Tuolumne River, etc.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 13	S. G. Bennett	8.35	[a]9,476.00 [b]253.00 [c]5.00
	Total		9,734.00
Aug. 27	L. M. Lawson		[a]15.00 [b]105.00 [c]4.00
	Total		124.00

[a] River. [b] Turlock Canal. [c] La Grange Ditch and Hydraulic Mining Company's canal.

Estimated monthly discharge of Tuolumne River exclusive of canals at Lagrange, Stanislaus County.

[Drainage area 1,501 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
August						
September	2,182	78	263	15,635	0.18	0.20
October	299	78	134	8,231	.09	.10
November	129	112	113	6,698	.08	.08
December	1,004	129	270	16,614	.18	.21
1896.						
January	7,610	350	2,312	142,159	1.54	1.78
February	1,780	1,080	1,164	66,954	.78	.84
March	11,798	1,006	2,725	167,578	1.82	2.10
April	7,990	2,670	3,522	209,574	2.34	2.60
May	10,100	2,670	4,429	272,371	2.95	3.40
June	9,320	5,140	7,692	457,705	5.13	5.74
July	5,330	960	3,003	184,677	2.00	2.31
August	3,050	227	485	29,828	.32	.37
September	1,620	132	432	25,742	.29	.32
October	350	75	120	7,366	.08	.09
November	5,710	227	1,135	67,543	.75	.83
December	3,620	670	1,083	66,603	.72	.83
The year [a]	11,798	75	2,342	1,698,100	1.56	21.21

[a] During 1896 there was no water in the Turlock Canal, and the Lagrange Ditch and Hydraulic Mining Company's Canal was flowing 32 second-feet approximately. The Lagrange Ditch and Hydraulic Mining Company's Canal was flowing approximately 35 second-feet during 1895.

Estimated monthly discharge of Tuolumne River, etc.—Continued.

Month	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1897.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	3,930	660	1,231	75,692	0.82	0.94
February	13,200	1,840	5,172	287,238	3.45	3.59
March	10,800	2,500	4,032	247,920	2.69	3.10
April	13,500	3,280	7,735	460,263	5.15	5.75
May	14,700	9,600	11,923	733,121	7.94	9.15
June	9,300	2,500	5,673	337,566	3.78	4.22
July	4,840	480	2,181	134,105	1.45	1.67
August	570	76	237	14,573	.16	.18
September	140	28	86	5,117	.06	.07
October	750	76	222	13,650	.15	.17
November	3,540	260	768	45,699	.51	.57
December	4,060	570	1,104	67,883	.74	.85
The year[a]	14,700	28	3,364	2,422,827	2.24	30.26
1898.						
January	750	300	454	27,916	0.30	0.35
February	2,500	300	900	49,983	.60	.63
March	2,060	750	1,224	75,261	.82	.94
April	7,800	1,270	4,014	238,849	2.67	2.78
May	6,960	2,280	4,620	284,075	3.08	3.55
June	3,280	750	2,247	133,705	1.50	1.73
July	750	88	277	17,032	.19	.21
August	100	76	85	5,226	.06	.07
September	88	0	20	1,190	.01	.01
October	88	32	52	3,197	.03	.04
November	82	16	39	2,321	.03	.03
December	2,060	32	256	15,741	.17	.20
The year[b]	7,800	0	1,182	854,496	.79	10.54

[a] There was no discharge from the Turlock Canal during the year 1897 past the Lagrange gaging station. It was wasted into the river above. For flow of the Lagrange Ditch and Hydraulic Mining Company's Canal, see special measurements of that canal.

[b] During the year 1898 the Turlock Canal was not discharging any material amount of water past the Lagrange gaging station, and the Lagrange Ditch and Hydraulic Mining Company's Canal was carrying about 24 second feet.

Estimated monthly discharge of Tuolumne River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,940	110	487	29,945	0.32	0.37
February	1,440	410	740	41,098	.49	.51
March	21,800	570	3,616	222,341	2.41	2.78
April	8,040	2,285	5,193	309,004	3.46	3.86
May	8,680	2,080	4,513	277,495	3.01	3.47
June	9,960	2,285	6,660	360,594	4.04	4.51
July	2,490	330	1,010	62,103	.67	.77
August	570	45	145	8,916	.10	.11
September	45	15	33	1,964	.02	.02
October	2,285	5	505	31,051	.34	.39
November	6,400	660	2,428	144,476	1.62	1.81
December	8,040	850	3,047	187,354	2.03	2.04
The year [a]	21,800	5	2,315	1,676,341	1.54	20.64
1900.						
January	13,160	1,060	2,384	146,586	1.59	1.83
February	1,300	750	967	53,704	.64	.67
March	3,100	950	2,343	144,065	1.56	1.80
April	4,320	1,440	2,389	142,155	1.59	1.77
May	9,320	3,100	6,796	417,870	4.53	5.23
June	8,680	2,285	5,291	314,836	3.53	3.94
July	1,740	140	694	42,672	.46	.53
August	140	0	43	2,644	.03	.03
September	110	0	11	655	.01	.01
October	5,760	35	1,228	75,507	.82	.94
November	14,440	410	2,536	150,902	1.69	1.89
December	2,080	850	1,332	81,902	.89	1.02
The year [b]	14,440	0	2,160	1,573,498	1.45	19.66

[a] For record of discharge of Turlock Canal beginning July 1, 1899, see Turlock Canal. Lagrange Ditch and Hydraulic Mining Company's Canal discharged about 24 second-feet during the year.

[b] For discharge of Turlock Canal for 1900 see Turlock Canal. Lagrange Ditch and Hydraulic Mining Company's Canal, January 1 to June 23, 24 second-feet; from June 24 to October 20, 12 second-feet; and from October 21 to December 31, 10 second-feet.

Estimated monthly discharge of Tuolumne River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1901.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	18,280	560	3,351	206,145	2.23	2.57
February	19,240	1,440	7,204	400,090	4.80	5.00
March	7,080	2,080	3,720	228,733	2.48	2.86
April	7,080	1,740	3,961	235,696	2.64	2.94
May	13,160	4,075	8,036	494,114	5.35	6.18
June	13,160	4,900	9,387	558,566	6.25	6.97
July	9,960	1,440	3,701	227,566	2.47	2.85
August	2,080	200	784	48,206	.52	.60
September	350	55	175	10,413	.12	.13
October	1,590	0	211	12,974	.14	.16
November	1,300	300	574	34,155	.38	.43
December	5,800	200	1,339	82,332	.89	1.02
The year [a]	19,240	0	3,537	2,538,990	2.37	31.71
1902.						
January	850	200	352	21,644	0.23	0.26
February	6,780	250	1,443	80,140	.96	1.00
March	5,810	1,180	2,103	129,308	1.40	1.61
April	12,630	1,320	4,735	281,752	3.15	3.51
May	11,360	2,470	6,334	389,462	4.22	4.86
June	11,360	3,140	6,519	387,907	4.34	4.84
July	2,690	350	998	61,365	.66	.76
August	300	0	91	5,595	.06	.07
September	200	35	89	5,296	.06	.07
October	560	15	113	6,948	.08	.09
November	2,690	250	676	40,225	.45	.50
December	2,690	350	809	49,743	.54	.62
The year	12,630	0	2,022	1,459,385	1.35	18.19

[a] Record for Turlock Canal for 1901 is incomplete. The Lagrange Ditch and Hydraulic Mining Company's Canal discharged from January 1 to March 31, 10 second-feet; April 1 to July 28, 7 second-feet, and flow was not material after that.

Discharge measurements of Lagrange Ditch and Hydraulic Mining Company's Canal.

Date.	Hydrographer.	Discharge.
1896.		*Sec.-feet.*
Apr. 15	J. A. Vogleson	32.0
1897.		
May 29	J. B. Lippincott	22.0
Oct. 30	A. Q. Campbell	6.2
Dec. 20	J. B. Lippincott	24.0
1898.		
Apr. 18	J. B. Lippincott	[a] 30.0
May 31	do	26.0
July 30	do	24.0
Oct. 7	do	24.0
1899.		
Mar. 3	J. B. Lippincott	24.0
Apr. 21	S. G. Bennett	23.5
June 29	do	24.0
Aug. 3	do	24.0
Sept. 11	do	24.0
1900.		
Apr. 5	S. G. Bennett	24.0
June 22	do	12.5
Aug. 11	do	12.0
1901.		
Apr. 7	S. G. Bennett	7.2
Aug. 31	do	4.5

[a] Estimated.

Discharge measurements of Turlock canal, Lagrange, Stanislaus County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
1897.			
Sept. 7	A. Q. Campbell	.....	43.0
1898.			
Oct. 7	J. B. Lippincott	.....	30.0
1899.			
Apr. 21	S. G. Bennett	.....	10.0
May 20	do	.....	61.0
June 6	do	.....	10.0
June 29	do	0.75	18.0
Aug. 4	do	1.70	85.0
Sept. 9	do	1.0	29.0
1900.			
Apr. 6	S. G. Bennett	2.0	129.0
June 22	do	.50	9.5
Aug. 11	do	1.90	117.0
Sept. 8	do	1.15	35.0
1901.			
Aug. 31	S. G. Bennett	.0	.0
1902.			
May 13	S. G. Bennett	2.92	253.0
July 23	do	3.0	260.0
Aug. 27	L. M. Lawson	2.6	105.0

Estimated monthly discharge of Turlock canal at Lagrange, Stanislaus County.

Month.	Discharge.		
	Maximum.	Minimum.	Mean.
1899.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*
July	48	1	11
August	86	1	55
September	34	8	19
October	10	1	7
November	3	0	1
December	0	0	0
1900.			
January	0	0	0
February	133	28	62
March	133	64	84
April	133	0	90
May	133	133	133
June	133	9	71
July	133	0	120
August	133	0	57
September	36	0	26
October	0	0	0
November	0	0	0
December	0	0	0
The year	133	0	54
1902.			
January	0	0	0
February	0	0	0
March	286	0	187
April	360	0	268
May	380	0	325
June	420	400	406
July	460	215	405
August	367	105	287
September	47	0	0
October	0	0	0
November	0	0	0
December	0	0	0
The year	460	0	156

Discharge measurements of Tuolumne River at Modesto, Stanislaus County.

Date.	Hydrographer.	Gage height.	Discharge.
1895.		*Feet.*	*Sec.-ft.*
Jan. 8	J. B. Lippincott	7.7	3,003
Mar. 21	do	6.75	2,429
May 1	do	10.25	6,078
May 2	do	12.9	13,546
June 27	do	13.0	9,308
Aug. 27	A. P. Davis	4.0	294
Nov. 30	J. B. Lippincott	3.42	213
1896.			
Apr. 14	J. A. Vogleson	7.9	3,745
July 4	C. C. Babb	9.6	3,719
Sept. 5	H. Crowe	4.5	362
Oct. 31	J. B. Lippincott	3.92	375

Estimated monthly discharge of Tuolumne River at Modesto, Stanislaus County.[a]

[Drainage area, 1,635 square miles.]

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1878.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
November			65	3,868	0.04	0.04
December			65	3,996	.04	.05
1879.						
January			478	29,391	0.29	0.33
February	14,230		1,876	104,187	1.15	1.20
March	6,920	830	2,797	171,980	1.71	1.97
April	8,360	2,350	4,456	265,150	2.73	3.04
May	8,230	2,740	5,086	312,726	3.11	3.59
June	11,870	4,670	7,061	420,158	4.32	4.79
July	4,670	570	1,977	121,560	1.21	1.39
August			183	11,252	.11	.13
September			39	2,321	.02	.02
October			30	1,844	.02	.02
November			101	6,010	.06	.07
December	4,790	140	903	55,523	.55	.63
The year			2,082	1,502,102	1.27	17.18

[a] Collected by California State engineering department from 1878 to 1884, inclusive.

Estimated monthly discharge of Tuolumne River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1880.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	1,290	170	409	25,148	0.25	0.29
February	5,150	130	625	35,950	.38	.41
March	1,550	370	832	51,157	.51	.59
April	19,300	770	7,141	424,918	4.37	4.87
May	16,300	6,280	10,371	637,687	6.34	7.31
June	17,050	10,340	14,075	837,521	8.61	9.61
July	13,220	3,295	7,618	468,412	4.66	5.37
August	2,960	300	1,233	75,814	.75	.86
September			134	7,973	.08	.09
October			56	3,443	.03	.03
November			35	2,082	.02	.02
December	5,020		1,095	67,328	.67	.77
The year			3,635	2,637,433	2.22	30.22
1881.						
January	22,900	2,640	2,884	177,330	1.76	2.03
February	5,020	2,440	6,755	375,153	4.13	4.30
March	10,340	3,290	2,879	177,022	1.76	2.03
April	10,200	4,790	6,260	372,495	3.83	4.27
May	8,630	3,540	7,274	447,261	4.45	5.13
June	3,970	690	5,225	310,909	3.20	3.57
July	1,380		1,996	122,729	1.22	1.41
August			391	24,041	.24	.28
September			125	7,437	.08	.09
October			130	7,993	.08	.09
November			193	11,484	.12	.13
December			620	38,122	.38	.44
The year			2,894	2,071,976	1.77	23.77

Estimated monthly discharge of Tuolumne River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1882.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January			620	38,122	0.38	0.44
February	1,360		573	31,823	.35	.36
March	11,410	430	2,164	133,059	1.32	1.52
April	5,780	2,270	3,543	210,823	2.17	2.42
May	11,250	4,670	7,461	458,759	4.56	5.26
June	13,670	4,550	8,046	478,770	4.92	5.49
July	5,650	890	2,745	168,783	1.68	1.94
August			574	35,294	.35	.40
September			255	13,388	.14	.16
October			873	43,678	.53	.61
November			570	33,917	.35	.39
December			327	20,106	.20	.23
The year			2,310	1,666,522	1.41	19.22
1883.						
January			654	40,211	0.40	0.46
February			490	27,213	.30	.31
March			1,310	80,548	.80	.92
April			3,270	194,578	2.00	2.23
May			8,180	502,968	5.00	5.76
June			6,540	389,157	4.00	4.46
July			1,635	100,532	1.00	1.15
August			490	30,129	.30	.35
September			327	19,457	.20	.22
October			262	16,110	.16	.18
November			327	19,457	.20	.22
December			327	20,106	.20	.23
The year			1,984	1,440,466	1.21	16.49
1884.						
January			410	25,210	0.25	0.29
February			490	28,185	.30	.32
March			6,540	402,129	4.00	4.61
April			7,360	437,950	4.50	5.02
May			7,360	452,548	4.50	5.20
June			8,180	486,743	5.00	5.58
July			6,540	402,129	4.00	4.61
August			1,635	100,532	1.00	1.15
September			327	19,457	.20	.22
October			245	15,064	.15	.17

Estimated monthly discharge of Tuolumne River, etc.—Continued.

Month.	Discharge.			Total discharge.	Run-off.	
	Maximum.	Minimum.	Mean.		Per square mile.	Depth.
1895.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Acre-feet.*	*Sec.-feet.*	*Inches.*
January	16,130	1,398	4,828	296,900	3.22	3.70
February	19,650	1,322	3,915	217,430	2.61	2.72
March	10,785	1,710	3,165	194,610	2.11	2.43
April	10,012	3,255	5,824	346,570	3.88	4.33
May	16,000	6,097	11,798	725,400	7.87	9.07
June	12,530	5,616	9,163	545,110	6.11	6.82
July	6,692	1,550	3,831	235,540	2.55	2.94
August	1,550	285	848	52,125	.57	.65
September	5,616	200	615	36,600	.41	.46
October	200	120	152	9,346	.10	.12
November	500	210	255	14,985	.17	.19
December	730	180	283	17,405	.19	.22
The year	19,650	120	3,719	2,692,021	2.45	33.65
1896.						
January	13,868	246	3,080	189,370	2.05	2.37
February	1,880	950	1,182	68,007	.79	.86
March	11,798	1,006	2,725	167,578	1.82	2.10
April	14,873	1,970	3,577	212,828	2.38	2.66
May	14,754	2,550	5,180	318,500	3.45	3.98
June	14,754	6,990	11,648	693,104	7.09	7.87
July	8,735	1,306	4,121	253,408	2.75	3.17
August	1,118	300	575	35,392	.38	.44
September	2,918	220	574	34,191	.38	.43
October	474	180	224	13,797	.15	.17
November	7,802	273	1,210	72,012	.81	.90
December	3,560	516	1,028	63,247	.69	.79
The year	14,754	180	2,927	2,121,434	1.90	25.74

TWIN CREEKS.

Discharge measurements of East Twin Creek in Canyon, San Bernardino County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
1898.		
June 11	J. B. Lippincott	[a] 1.95
		[b] .11
	Total	2.06
Sept. 9	J. B. Lippincott	[a] .43
Sept. 9	do	[b] .30
	Total	.73
1899.		
Mar. 24	S. G. Bennett	[a] 3.88
Mar. 24	do	[b] .50
	Total	4.38
Aug. 25	S. G. Bennett	[a] .58
Aug. 25	do	[b] .16
	Total	.74
1900.		
July 12	S. G. Bennett	[a] .62
		[b] .15
	Total	.77
Oct. 1	W. W. Cockins, jr	[a] .36
		[b] .21
	Total	.57
1902.		
Apr. 1	S. G. Bennett	[c] 4.7
		[b] .2
	Total	4.9
Sept. 1	W. B. Clapp	.4

[a] Ditch. [b] Tunnel. [c] Creek.

Discharge measurements of West Twin Creek in Canyon, San Bernardino County.

Date.	Hydrographer.	Discharge.
1898.		*Sec.-feet.*
June 11	J. B. Lippincott	[a] 1.06 [b] .68 [c] .40
	Total	2.14
Sept. 9	J. B. Lippincott	.38
1899.		
Mar. 21	S. G. Bennett	3.00
Aug. 25	do	.20
1900.		
July 12	do	.22
Oct. 1	W. W. Cockins, jr	.16
1902.		
Apr. 4	S. G. Bennett	3.20
Sept. 4	W. B. Clapp	.13

[a] Pipe line to Waterman Ranch. [b] Flume to Settlers. [c] Hot Springs at Old Ranch.

WALKER RIVER.

Discharge measurements of Walker River, East Fork.

Date.	Hydrographer.	Discharge.	Location.
1902.		*Sec.-feet.*	
July 24	L. H. Taylor	196.5	10 miles below Bridgeport.
Aug. 27	D. W. Hays	79.5	Lower end Bridgeport Valley.
Oct. 6	do	57.6	Below all diversions in California.
July 26	F. H. Olmsted	119.8	Robinson Creek below Twin Lakes.
Aug. 21	D. W. Hays	75.7	Do.
Do	do	43.2	Buckeye Creek west of Bridgeport.
Oct. 6	do	24.0	Robinsons Creek, Twin Lakes.
Do	do	20.0	Buckeye Creek, Buckeye Springs.
Oct. 7	do	4.2	Somers, southwest of Bridgeport.
Do	do	7.12	Green Creek above Standard Dam.
Oct. 5	do	5.7	Virginia Creek bridge at Huntoon Ranch.

Discharge measurements of Walker River, West Fork.

Date.	Hydrographer.	Discharge.	Location.
1902.		*Sec.-feet.*	
July 22	F. H. Olmsted	417.0	3 miles above Larsens.
Do	do	15.5	Silver Creek.
July 23	do	10.5	Quinton Creek.
Do	do	71.5	Leavitt.
July 24	do	95.0	At Middle Fork.
July 25	L. H. Taylor	330.6	Upper end Antelope Valley.
Aug. 23	D. W. Hays	69.7	Do.
Oct. 1	do	69.8	Do.
Aug. 8	do	221.8	Bridge above tollhouse.

Discharge measurement of Big Walker River, Leavitts, Mono County.

Date.	Hydrographer.	Discharge.	Location.
1896.		*Sec.-feet.*	
Oct. 18	J. B. Lippincott	45	

Discharge measurement of Little Walker River, Hardys, Mono County.

Date.	Hydrographer.	Discharge.	Location.
1896.		*Sec.-feet.*	
Oct. 17	J. B. Lippincott	39	
1902.			
July 21.	F. H. Olmsted	101.6	Blackburns Junction.

WARD AND WARREN DITCH.

See San Bernardino Valley.

WARM CREEK.

WARM CREEK, HAWES AND TALMADGE DITCH.

See San Bernardino Valley.

WARM CREEK, M'KENZIE DITCH.

See San Bernardino Valley.

WARM CREEK, MEEKS AND DAILY DITCH.

See San Bernardino Valley.

WARM CREEK, RABEL DITCH (DAM).

See San Bernardino Valley.

WARM CREEK, SHAY OR STOUT DITCH.

See San Bernardino Valley.

WHITE CREEK.

Estimated monthly discharge of White Creek at base of foothills, Tulare County.[a]

[Drainage area, 90 square miles.]

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1879.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	7	430	0.08	0.09
February	12	666	.14	.14
March	6	369	.07	.08
April	23	1,368	.25	.28
May	16	984	.18	.21
June	5	297	.06	.07
July	0		0	0
August	0		0	0
September	0		0	0
October	0		0	0
November	23	1,368	.25	.28
December	45	2,767	.50	.58
The year	11	8,249	.13	1.73

[a] The entire record is estimated from records of neighboring drainage basins. Authority, California State engineering department.

Estimated monthly discharge of White Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1880.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	108	6,640	1.20	1.38
February	207	11,906	2.30	2.48
March	234	14,388	2.60	3.00
April	261	15,530	2.90	3.24
May	180	11,067	2.00	2.31
June	45	2,677	.50	.56
July	5	307	.06	.07
August	0	.....	0	0
September	0	.....	0	0
October	0	.....	0	0
November	18	1,071	.20	.22
December	45	2,767	.50	.58
The year	92	66,353	1.02	13.84
1881.				
January	45	2,767	0.50	0.58
February	90	4,998	1.00	1.04
March	90	5,534	1.00	1.15
April	90	5,355	1.00	1.12
May	90	5,534	1.00	1.15
June	45	2,677	.50	.56
July	0	.....	0	0
August	0	.....	0	0
September	0	.....	0	0
October	0	.....	0	0
November	0	.....	0	0
December	11	676	.12	.14
The year	38	27,541	.42	5.74

Estimated monthly discharge of White Creek, etc.—Continued.

Month.	Mean discharge.	Total discharge.	Run-off.	
			Per square mile.	Depth.
1882.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	11	676	0.12	0.14
February	14	777	.15	.16
March	45	2,767	.50	.58
April	45	2,677	.50	.56
May	9	553	.10	.12
June	0		0	0
July	0		0	0
August	0		0	0
September	0		0	0
October	9	553	.10	.12
November	14	833	.15	.17
December	5	307	.06	.07
The year	13	9,143	.14	1.92
1883.				
January	14	861	0.15	0.17
February	14	777	.15	.16
March	72	4,427	.80	.92
April	45	2,677	.50	.56
May	36	2,213	.40	.46
June	0		0	0
July	0		0	0
August	0		0	0
September	0		0	0
October	9	553	.10	.12
November	9	535	.10	.11
December	14	861	.15	.17
The year	18	12,904	.19	2.67

Estimated monthly discharge of White Creek, etc.—Continued.

Month	Mean discharge.	Total discharge.	Run-off	
			Per square mile.	Depth.
1884.	*Second-feet.*	*Acre-feet.*	*Second-feet.*	*Inches.*
January	45	2,767	0.50	0.58
February	270	15,530	3.00	3.24
March	270	16,601	3.00	3.45
April	180	10,710	2.00	2.23
May	36	2,213	.40	.46
June	45	2,677	.50	.56
July	0	.....	0	0
August	0	.....	0	0
September	0	.....	0	0
October	0	.....	0	0

WHITEWATER RIVER.

Discharge measurements of Whitewater River and tributaries at various points, San Bernardino and Riverside counties.

Date.	Hydrographer.	Discharge.	Locality
		Sec.-feet	
Feb. 15, 1898	J. B. Lippincott	7.42	South Fork at tunnel.
Mar. 4, 1899	do	2.52	Do.
Feb. 16, 1898	do	14.24	Main river at foot of Bear Valley trail.
Feb. 17, 1898	do	4.64	North Fork at mouth.
Do	do	.82	Middle Fork at mouth.
Do	do	17.77	Main river 2 miles above mouth.

Discharge measurements of Bear Valley Ditch, Riverside County.

Date.	Hydrographer.	Discharge.	Locality.
		Sec.-feet.	
Feb. 14, 1898	J. B. Lippincott	3.05	¼ mile northeast of ranch house.
Sept. 28, 1899	do	5.20	At headgate.
Sept. 29, 1899	do	2.49	1 mile below headgate.

Discharge measurements of Bear Valley and Palm Spring joint headworks, mouth of Canyon, Riverside County.

Date.	Hydrographer.	Discharge.
		Sec.-feet.
Sept. 7, 1898	J. B. Lippincott	9.35
Aug. 25, 1899	S. G. Bennett	6.34

WHITING DITCH.

See San Bernardino Valley.

WILLOW CREEK.

See Susan River.

YUBA RIVER.

Discharge measurements of Yuba River.

Date.	Hydrographer.	Discharge.	Locality
1878.		*Sec.-feet.*	
Dec. 9	State engineering department.	510	Marysville.
Dec. 12	do	510	3 miles below Smartsville.
1879.			
Feb. 14	do	18,000	Marysville.
Mar. 6	do	25,750	Do.
Mar. 9	do	11,500	Do.
Mar. 12	do	9,500	Do.
Mar. 19	do	7,000	Do.
Aug. 28	do	600	Smartsville to Marysville.

Discharge measurements of Yuba River below Parks Bar Bridge, Smartsville, Yuba County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
1900.		*Feet.*	*Sec.-feet.*
June 28	H. D. H. Connick	3.15	1,212
June 29	do	2.95	1,086
July 11	do	2.65	820
July 12	do	2.65	811
July 13	do	2.60	774
July 22	do	2.42	622
July 23	do	2.50	686
July 24	do	2.50	673
Aug. 7	do	2.23	537
Aug. 8	do	2.30	571
Aug. 11	do	2.25	534
Aug. 28	do	2.20	474
Sept. 11	do	2.60	736
1902.			
Sept. 1	Chas. A. Miller	.....	487

Discharge measurements of Yuba River, North Fork, above power company's dam, Yuba County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
1900.		*Feet.*	*Sec.-feet.*
July 3	H. D. H. Connick	2.05	606
July 6	do	1.95	567
July 17	do	1.70	438
July 18	do	1.65	419
July 27	do	1.65	366
July 29	do	1.60	371
July 31	do	1.60	364
Aug. 9	do	1.55	328
Aug. 10	do	1.57	322
Aug. 29	do	1.48	282
Aug. 30	do	1.48	285

Discharge measurements of Yuba River, Middle Fork, at Freemans Bridge, Yuba County, Cal.

Date.	Hydrographer.	Gage height.	Discharge.
1900.		*Feet.*	*Sec.-feet*
July 1	H. D. H. Connick	2.40	191
July 3	do	2.35	180
July 4	do	2.30	185
July 7	do	2.57	162
July 29	do	2.30	109
Aug. 11	do	2.17	79
Aug. 12	do	2.15	78
Aug. 29	do	2.20	69
Aug. 30	do	2.20	68
Sept. 18	do	2.15	64

Discharge measurements of Yuba River, Yuba County, Cal.

Date.	Hydrographer.	Discharge.	Locality.
1902.		*Sec.-feet.*	
Aug. 29	S. G. Bennett	58	South Fork, at Eldorado bridge.
Aug. 30	Chas. A. Miller	55	South Fork, at Bridgeport bridge.
Sept. 1	do	32	Excelsior Mining and Irrigation canal, at Pleasant Valley.
	Total	87	
Aug. 29	S. G. Bennett	58	South Fork, 75 feet above Edwards bridge.
Do	do	9.3	South Fork, North Columbia, Eureka Lake Company's canal.
Do	do	7.0	South Fork, North Bloomfield ditch.
Aug. 30	do	52	Middle Fork, ¼ mile below Delihi mine.
Sept. 1	do	64	Middle Fork, 300 feet below Freemans bridge.
Do	do	221	North Fork, Bay Counties Electric Co.'s flume, below headgate.

MAXIMUM FLOOD MEASUREMENTS.

The following flood measurements are given as having probable interest to the engineer in connection with the designing of bridges and of spillways for reservoirs. It is not intended that these should be considered as the maximum floods that will ever occur on these drainage basins. They are rather given as a record of the largest observed volumes known to the author. It is, of course, exceedingly difficult to measure accurately a river in great flood, and it seldom falls to the fortune of a hydrographer to be present at the maximum flood wave, but it is believed that these data may be valuable for the purposes mentioned:

Gila River at Florence, Ariz., February, 1891; 17,750 square miles drainage area; discharge, 102,500 second-feet, or 7.5 second-feet per square mile.

Salt River, Arizona, February, 1891; area of drainage, 12,000 square miles; flood discharge, 300,000 second-feet, or 24.6 second-feet per square mile.

Gila River at Gila bend, February, 1891, probable flood discharge, 250,000 second-feet.

Mormon Canyon, Los Angeles County, 15½ square miles drainage; elevation from 1,000 to 3,800; flood discharge by Schuyler from 700 to 800 second-feet, or 48.5 second-feet per square mile.

Sweetwater River, 186 square miles drainage area; January, 1895, 18,150 second-feet, or 97.5 second-feet per square mile.

Tuolumne River at La Grange dam, drainage area, 1,501 square miles; elevations to 14,000 feet; flood discharge, 46,000 second-feet, or 30.6 second-feet per square mile.

Yuba River, South Fork, at Bowman dam, elevation, 5,500 feet; drainage area, 19 square miles; discharge, 5,000 to 7,000 second-feet from melting snow, or 316 second-feet per square mile.

Cherry Creek, Colorado, area, 175 square miles; flood discharge, 10,000 second-feet, or 57 second-feet per square mile.

Maximum floods measured by the United States Geological Survey, 1896–1901.

Date.	Stream.	Locality.	Area of watershed	Maximum measurements.	Discharge per square mile
			Sq. miles.	*Sec.-feet.*	*Sec. feet*
	Arroyo Seco (Salinas).	Above diversion	218	24,050	110.23
1885	Kern	Near Bakersfield	2,345	9,380	4.00
1901	King	Red Mountain	1,742	43,930	25.21
1901	Mokelumne	Electra	640	13,213	20.64
1896	Sacramento	Jellys Ferry	9,134	130,050	14.23
1900	San Antonio	Near Jolon (above Pinkerton dam site).	322	15,315	47.56
1901	San Gabriel	Azusa	222	6,250	28.15
1901	San Joaquin	Herndon	1,637	21,372	13.05
1900	San Lorenzo		235	10,269	42.00
1900	Santa Ana	Warm Spring	188	1,564	8.32
1899	Stanislaus	Oakdale	1,051	13,940	13.26
1900	Stony Creek	Julian's ranch	760	[a] 18,000	23.76+
1899	Tuolumne	Lagrange	1,501	21,800	14.52

[a] Gage height, 14. February, 1902, gage height reached 15.7.

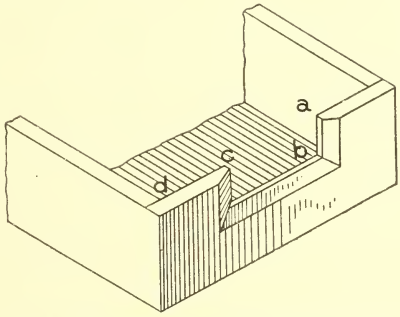

FIG. 4.—Figure showing construction of weir.

It has been found that the usual method of measuring the head on weirs, as practiced by water companies and water users, is to use an ordinary foot rule divided into inches and sixteenths. As no general weir table is available for heads so measured, the following has been prepared.

WEIR

The following conditions should be observed in construction of weir: depth of box or canal, and distance *c d* of opening from side of canal

Discharges in second-feet, rectangular weirs

[Formula Q = 3.33

Head		Length of weir.												
	Feet	3 in.	6 in.	9 in.	12 in.	15 in.	18 in.	24 in.	2 ft. 6 in.	3 ft.	3 ft. 6 in.	4 ft.	4 ft. 6 in.
1		0.005											
2		0.0010	0.0011	0.0017	0.0026	0.00353							
3		.015	.0021	.0032	.0048	.00648							
4		.021	.0033	.0050	.0075	.00997	0.0125	0.0150	0.0200	0.0250	0.0300	0.0350	0.0400	0.0450
5		.026	.0046	.0069	.0104	.0139	.0174	.0209	.0279	.0349	.0419	.0489	.0559	.0629
6		.031	.0060	.0091	.0137	.0183	.0229	.0275	.0367	.0459	.0551	.0643	.0735	.0827
7		.036	.0075	.0114	.0172	.0230	.0288	.0346	.0462	.0578	.0694	.0810	.0926	.104
8		.042	.0092	.0139	.0210	.0281	.0352	.0422	.0564	.0706	.0847	.0989	.113	.127
9		.047	.0110	.0166	.0250	.0335	.0419	.0504	.0673	.0842	.101	.118	.135	.152
10		.052	.0128	.0194	.0293	.0392	.0491	.0590	.0788	.0986	.118	.138	.158	.178
11		.057	.0147	.0223	.0337	.0451	.0566	.0680	.0908	.114	.136	.159	.182	.205
12		.062	.0167	.0254	.0384	.0514	.0644	.0774	.103	.129	.155	.181	.207	.233
13		.068	.0187	.0285	.0432	.0579	.0725	.0872	.117	.146	.175	.205	.234	.263
14		.073	.0209	.0318	.0482	.0646	.0810	.0974	.130	.163	.196	.229	.261	.294
15		.078	.0231	.0352	.0534	.0716	.0897	.108	.144	.181	.217	.253	.290	.326
16	1	.083	.0254	.0387	.0587	.0788	.0988	.119	.159	.199	.239	.279	.319	.359
17		.088	.0277	.0423	.0642	.0862	.108	.130	.174	.218	.262	.305	.349	.393
18		.094	.0301	.0460	.0699	.0938	.118	.142	.189	.237	.285	.333	.381	.428
19		.099	.0325	.0498	.0757	.102	.128	.153	.205	.257	.309	.361	.413	.464
20		.104	.0349	.0536	.0816	.110	.138	.166	.222	.278	.334	.389	.445	.501
21		.109	.0375	.0576	.0877	.118	.148	.178	.238	.298	.359	.419	.479	.539
22		.115	.0401	.0616	.0939	.126	.159	.191	.255	.320	.385	.449	.514	.578
23		.120	.0427	.0657	.100	.135	.169	.204	.273	.342	.411	.480	.549	.618
24		.125	.0454	.0699	.107	.144	.180	.217	.291	.364	.438	.511	.585	.659
25		.130	.0481	.0742	.113	.152	.192	.231	.309	.387	.465	.544	.622	.700
26		.135	.0508	.0784	.120	.161	.203	.244	.327	.410	.493	.576	.659	.742
27		.140	.0536	.0829	.127	.171	.215	.259	.346	.434	.522	.610	.698	.785
28		.146	.0564	.0873	.134	.180	.226	.273	.365	.458	.551	.644	.736	.829
29		.151	.0593	.0919	.141	.190	.238	.287	.385	.483	.581	.678	.776	.874
30		.156	.0622	.0965	.148	.199	.251	.302	.405	.508	.611	.714	.816	.919
31		.161	.0651	.101	.155	.209	.263	.317	.425	.533	.641	.749	.857	.965
32	2	.167	.0680	.106	.162	.219	.276	.332	.446	.559	.672	.786	.899	1.012
33		.172	.0710	.111	.170	.229	.288	.348	.466	.585	.704	.822	.941	1.060
34		.177	.0740	.115	.177	.239	.301	.364	.488	.612	.736	.860	.984	1.108
35		.182	.0769	.120	.185	.250	.315	.379	.509	.638	.768	.898	1.027	1.157
36		.187	.0799	.125	.193	.260	.328	.395	.531	.666	.801	.936	1.071	1.206
37		.193	.0830	.130	.201	.271	.341	.412	.553	.694	.834	.975	1.116	1.257
38		.198	.0862	.135	.208	.282	.355	.428	.575	.722	.868	1.015	1.161	1.308
39		.203	.0893	.140	.216	.293	.369	.445	.597	.750	.902	1.055	1.207	1.359
40		.208	.0926	.145	.224	.303	.383	.462	.620	.778	.937	1.095	1.253	1.412
41		.213		.150	.233	.315	.397	.479	.643	.808	.972	1.136	1.300	1.465
42		.219		.155	.241	.326	.411	.496	.667	.837	1.007	1.178	1.348	1.518
43		.224		.160	.249	.337	.425	.514	.690	.867	1.043	1.219	1.396	1.572
44		.230		.165	.257	.349	.440	.531	.714	.897	1.079	1.262	1.444	1.627

TABLES.

The depth *a b* of weir (fig. 4, see p. 411) must not be over one-third must not be less than depth *a b*.

with end contractions; original computation.

(L —.2 H) $H^{\frac{3}{2}}$.]

Length of weir—Continued.											Addition for increase of length.		
5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	1 in.	1 ft.	
------	------	------	------	------	------	------	------	------	------	------	------	------	1
------	------	------	------	------	------	------	------	------	------	------	0.00029	0.00354	2
------	------	------	------	------	------	------	------	------	------	------	.00054	.00650	3
0.0500	0.0600	0.0700	0.0800	0.0900	0.100	0.120	0.140	0.160	0.180	0.200	.00083	.01001	4
.0698	.0838	.0978	.112	.126	.140	.168	.196	.224	.252	.280	.00117	.0140	5
.0918	.110	.129	.147	.166	.184	.221	.258	.294	.331	.368	.00153	.0184	6
.116	.139	.162	.185	.209	.232	.278	.324	.371	.417	.463	.00193	.0232	7
.141	.170	.198	.226	.255	.283	.340	.396	.453	.510	.566	.00236	.0283	8
.169	.203	.236	.270	.304	.338	.405	.473	.541	.608	.676	.00282	.0338	9
.198	.237	.277	.316	.356	.395	.475	.554	.633	.712	.791	.00330	.0396	10
.228	.273	.319	.365	.410	.456	.547	.639	.730	.821	.913	.00380	.0457	11
.260	.312	.364	.416	.468	.520	.624	.728	.832	.936	1.040	.00433	.0520	12
.293	.351	.410	.469	.527	.586	.703	.821	.938	1.055	1.173	.00489	.0587	13
.327	.392	.458	.524	.589	.655	.786	.917	1.048	1.179	1.310	.00546	.0656	14
.362	.435	.509	.582	.654	.726	.872	1.017	1.162	1.308	1.453	.00606	.0727	15
.399	.479	.559	.640	.720	.800	.960	1.120	1.280	1.441	1.601	.00667	.0801	16
.437	.525	.613	.700	.788	.876	1.051	1.227	1.402	1.578	1.753	.00731	.0877	17
.476	.572	.667	.763	.859	.954	1.145	1.337	1.528	1.719	1.910	.00796	.0956	18
.516	.620	.724	.827	.931	1.035	1.242	1.449	1.657	1.864	2.071	.00864	.104	19
.557	.669	.781	.893	1.005	1.117	1.341	1.565	1.789	2.013	2.237	.00933	.112	20
.600	.720	.841	.961	1.081	1.202	1.443	1.684	1.925	2.166	2.407	.01005	.120	21
.643	.772	.901	1.030	1.160	1.289	1.547	1.805	2.064	2.322	2.580	.0108	.129	22
.687	.825	.963	1.101	1.239	1.377	1.654	1.930	2.206	2.482	2.758	.0115	.138	23
.732	.879	1.026	1.174	1.321	1.468	1.762	2.057	2.351	2.645	2.940	.0123	.147	24
.778	.935	1.091	1.248	1.404	1.561	1.874	2.186	2.499	2.812	3.125	.0130	.156	25
.825	.991	1.157	1.323	1.489	1.655	1.967	2.319	2.650	2.982	3.314	.0138	.166	26
.873	1.049	1.224	1.400	1.576	1.751	2.102	2.454	2.805	3.156	3.507	.0146	.176	27
.922	1.107	1.293	1.478	1.664	1.849	2.220	2.591	2.962	3.333	3.704	.0155	.185	28
.971	1.167	1.362	1.558	1.753	1.949	2.340	2.731	3.122	3.513	3.904	.0163	.195	29
1.022	1.228	1.433	1.639	1.845	2.050	2.462	2.873	3.284	3.696	4.107	.0171	.206	30
1.073	1.289	1.505	1.721	1.937	2.153	2.586	3.018	3.450	3.882	4.314	.0180	.216	31
1.125	1.352	1.579	1.805	2.032	2.258	2.711	3.165	3.618	4.071	4.524	.0189	.227	32
1.178	1.416	1.653	1.890	2.127	2.365	2.839	3.314	3.788	4.263	4.737	.0198	.237	33
1.232	1.480	1.728	1.976	2.225	2.473	2.969	3.465	3.962	4.458	4.954	.0207	.248	34
1.286	1.546	1.805	2.064	2.323	2.582	3.101	3.619	4.138	4.656	5.174	.0216	.259	35
1.342	1.612	1.882	2.153	2.423	2.693	3.234	3.775	4.316	4.856	5.397	.0225	.270	36
1.398	1.680	1.961	2.243	2.525	2.806	3.370	3.933	4.497	5.060	5.623	.0235	.282	37
1.455	1.748	2.041	2.334	2.627	2.921	3.507	4.093	4.680	5.266	5.853	.0244	.293	38
1.512	1.817	2.122	2.427	2.731	3.036	3.646	4.256	4.865	5.475	6.085	.0254	.305	39
1.570	1.887	2.203	2.520	2.837	3.153	3.787	4.420	5.053	5.686	6.320	.0264	.317	40
1.629	1.958	2.286	2.615	2.943	3.272	3.929	4.586	5.244	5.901	6.558	.0274	.329	41
1.689	2.029	2.370	2.711	3.051	3.392	4.074	4.755	5.436	6.118	6.799	.0284	.341	42
1.749	2.102	2.455	2.808	3.161	3.514	4.219	4.925	5.631	6.337	7.043	.0294	.353	43
1.810	2.175	2.540	2.906	3.271	3.636	4.367	5.098	5.828	6.559	7.290	.0304	.365	44

Discharges in second-feet, rectangular

Head			Length of weir.											
	Inches.	Feet.	4 in.	6 in.	9 in.	12 in.	15 in.	18 in.	24 in.	2 ft. 6 in.	3 ft.	3 ft. 6 in.	4 ft.	4 ft. 6 in.
45	2½	0.234		0.171	0.266	0.360	0.455	0.549	0.738	0.927	1.116	1.305	1.494	1.683
46	2¾	.240		.177	.274	.372	.469	.567	.762	.958	1.153	1.348	1.543	1.739
47	2¾	.245		.182	.283	.384	.484	.585	.787	.989	1.190	1.392	1.594	1.795
48	3	.250		.187	.291	.395	.499	.604	.812	1.020	1.228	1.436	1.644	1.852
49	3⅛	.255		.193	.300	.407	.515	.622	.837	1.051	1.266	1.481	1.695	1.910
50	3¼	.260		.198	.309	.420	.530	.641	.862	1.083	1.305	1.526	1.747	1.968
51	3⅜	.266		.204	.318	.432	.546	.660	.888	1.116	1.343	1.571	1.799	2.027
52	3½	.271		.209	.327	.444	.561	.679	.913	1.148	1.383	1.617	1.852	2.087
53	3⅝	.276		.205	.336	.456	.577	.698	.939	1.181	1.422	1.664	1.905	2.147
54	3¾	.281		.220	.345	.469	.593	.717	.966	1.214	1.462	1.711	1.959	2.207
55	3⅞	.286		.226	.354	.481	.609	.737	.992	1.247	1.502	1.758	2.013	2.268
56	3	.292		.232	.363	.494	.625	.756	1.018	1.281	1.543	1.805	2.068	2.330
57	3 1/16	.297			.372	.507	.641	.776	1.045	1.315	1.584	1.853	2.123	2.392
58	3⅛	.302			.381	.520	.658	.796	1.072	1.349	1.625	1.902	2.178	2.455
59	3 3/16	.307			.391	.532	.674	.816	1.100	1.383	1.667	1.950	2.234	2.518
60	3¼	.312			.400	.545	.691	.836	1.127	1.418	1.709	2.000	2.291	2.581
61	3 5/16	.318			.409	.558	.708	.857	1.155	1.453	1.751	2.049	2.347	2.646
62	3⅜	.323			.419	.572	.724	.877	1.183	1.488	1.794	2.099	2.405	2.710
63	3 7/16	.328			.428	.585	.741	.898	1.211	1.524	1.837	2.150	2.463	2.775
64	4	.333			.438	.598	.758	.919	1.239	1.559	1.880	2.200	2.521	2.841
65	4 1/16	.338			.448	.612	.776	.940	1.267	1.595	1.923	2.251	2.579	2.907
66	4⅛	.344			.457	.625	.793	.961	1.296	1.632	1.967	2.303	2.638	2.974
67	4 3/16	.349			.467	.638	.810	.982	1.325	1.668	2.011	2.355	2.698	3.041
68	4¼	.354			.477	.652	.828	1.003	1.354	1.705	2.056	2.407	2.758	3.109
69	4⅜	.359			.486	.666	.845	1.025	1.383	1.742	2.101	2.459	2.818	3.177
70	4½	.365			.496	.680	.863	1.046	1.413	1.779	2.146	2.512	2.879	3.245
71	4⅝	.370			.506	.693	.881	1.068	1.442	1.817	2.191	2.565	2.940	3.314
72	4¾	.375			.516	.707	.899	1.090	1.472	1.854	2.237	2.619	3.001	3.384
73	4⅞	.380				.721	.917	1.112	1.502	1.892	2.283	2.673	3.063	3.454
74	4	.385				.735	.935	1.134	1.532	1.930	2.329	2.727	3.126	3.524
75	4 1/16	.390				.749	.953	1.156	1.562	1.969	2.375	2.782	3.188	3.595
76	4⅛	.396				.764	.971	1.178	1.593	2.008	2.422	2.837	3.252	3.666
77	4 3/16	.401				.778	.989	1.201	1.624	2.047	2.469	2.892	3.315	3.738
78	4¼	.406				.793	1.009	1.224	1.655	2.086	2.517	2.949	3.380	3.811
79	4⅜	.411				.807	1.028	1.246	1.686	2.125	2.565	3.004	3.444	3.883
80	5	.417				.821	1.045	1.269	1.717	2.164	2.612	3.060	3.508	3.956
81	5⅛	.422				.836	1.064	1.292	1.748	2.205	2.661	3.117	3.573	4.030
82	5¼	.427				.850	1.082	1.315	1.779	2.244	2.709	3.174	3.638	4.103
83	5⅜	.432				.864	1.101	1.337	1.810	2.284	2.757	3.230	3.703	4.177
84	5½	.437				.879	1.120	1.361	1.843	2.324	2.806	3.288	3.770	4.252
85	5⅝	.443				.893	1.138	1.383	1.874	2.364	2.855	3.345	3.836	4.326
86	5¾	.448				.908	1.158	1.407	1.906	2.405	2.904	3.404	3.903	4.402
87	5⅞	.453				.923	1.177	1.431	1.939	2.447	2.954	3.462	3.970	4.478
88	6	.458				.938	1.196	1.455	1.971	2.488	3.005	3.521	4.038	4.555
89	6⅛	.463				.953	1.216	1.479	2.004	2.530	3.055	3.581	4.106	4.632
90	6¼	.469				.968	1.235	1.502	2.037	2.571	3.105	3.640	4.174	4.708
91	6⅜	.474				.983	1.255	1.526	2.070	2.613	3.156	3.700	4.243	4.786
92	6½	.479				.998	1.274	1.550	2.103	2.655	3.207	3.760	4.312	4.864
93	6⅝	.484				1.014	1.295	1.575	2.137	2.698	3.259	3.821	4.382	4.943
94	6¾	.490				1.029	1.314	1.599	2.170	2.740	3.310	3.881	4.451	5.021

weirs with end contractions—Continued.

Length of weir—Continued.											Addition for increase of length.		
5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	1 in.	1 ft.	
1.871	2.249	2.627	3.005	3.383	3.761	4.516	5.272	6.028	6.783	7.539	0.0315	0.378	45
1.934	2.324	2.715	3.105	3.496	3.886	4.667	5.448	6.229	7.010	7.792	.0325	.391	46
1.997	2.400	2.804	3.207	3.610	4.013	4.820	5.627	6.433	7.240	8.047	.0336	.403	47
2.060	2.477	2.893	3.309	3.725	4.142	4.974	5.807	6.639	7.472	8.304	.0347	.416	48
2.125	2.554	2.983	3.413	3.842	4.271	5.130	5.989	6.847	7.706	8.565	.0358	.429	49
2.190	2.632	3.075	3.517	3.960	4.402	5.287	6.172	7.058	7.943	8.828	.0369	.443	50
2.255	2.711	3.167	3.623	4.079	4.535	5.446	6.358	7.270	8.182	9.093	.0380	.456	51
2.321	2.791	3.260	3.729	4.199	4.668	5.607	6.546	7.484	8.423	9.362	.0391	.469	52
2.388	2.871	3.354	3.837	4.320	4.803	5.769	6.735	7.701	8.666	9.632	.0402	.483	53
2.455	2.952	3.449	3.946	4.442	4.939	5.932	6.926	7.919	8.913	9.906	.0414	.497	54
2.524	3.034	3.545	4.055	4.566	5.076	6.097	7.118	8.140	9.161	10.182	.0425	.511	55
2.592	3.117	3.641	4.166	4.690	5.215	6.264	7.313	8.362	9.411	10.460	.0437	.525	56
2.661	3.200	3.739	4.277	4.816	5.355	6.432	7.509	8.586	9.664	10.741	.0449	.539	57
2.731	3.284	3.837	4.390	4.943	5.495	6.601	7.707	8.813	9.918	11.024	.0461	.553	58
2.801	3.369	3.936	4.503	5.070	5.638	6.772	7.907	9.041	10.176	11.310	.0473	.567	59
2.872	3.454	4.036	4.617	5.199	5.781	6.944	8.108	9.271	10.435	11.598	.0485	.582	60
2.944	3.540	4.136	4.733	5.329	5.925	7.118	8.311	9.503	10.696	11.889	.0497	.596	61
3.016	3.627	4.238	4.849	5.460	6.071	7.293	8.515	9.737	10.960	12.182	.0509	.611	62
3.088	3.714	4.340	4.966	5.592	6.218	7.470	8.722	9.973	11.225	12.477	.0522	.626	63
3.162	3.802	4.443	5.084	5.725	6.366	7.648	8.929	10.211	11.493	12.774	.0534	.641	64
3.235	3.891	4.547	5.203	5.859	6.515	7.827	9.139	10.451	11.763	13.074	.0547	.656	65
3.310	3.981	4.652	5.323	5.994	6.665	8.007	9.350	10.692	12.034	13.376	.0559	.671	66
3.384	4.071	4.757	5.443	6.130	6.816	8.189	9.562	10.935	12.308	13.681	.0572	.686	67
3.460	4.161	4.863	5.565	6.267	6.969	8.373	9.776	11.180	12.584	13.988	.0585	.702	68
3.535	4.253	4.970	5.688	6.405	7.122	8.557	9.992	11.427	12.862	14.296	.0598	.717	69
3.612	4.345	5.078	5.811	6.544	7.277	8.743	10.209	11.676	13.142	14.608	.0611	.733	70
3.689	4.438	5.186	5.935	6.684	7.433	8.930	10.428	11.926	13.423	14.921	.0624	.749	71
3.766	4.531	5.296	6.060	6.825	7.590	9.119	10.648	12.178	13.707	15.237	.0637	.765	72
3.844	4.625	5.405	6.186	6.967	7.748	9.309	10.870	12.432	13.993	15.554	.0650	.781	73
3.922	4.719	5.516	6.313	7.110	7.906	9.500	11.093	12.687	14.281	15.874	.0664	.797	74
4.001	4.814	5.627	6.440	7.253	8.066	9.692	11.318	12.944	14.570	16.196	.0677	.813	75
4.081	4.910	5.739	6.569	7.398	8.227	9.886	11.545	13.203	14.862	16.520	.0691	.829	76
4.161	5.007	5.852	6.698	7.544	8.390	10.081	11.772	13.464	15.155	16.847	.0705	.846	77
4.242	5.104	5.967	6.829	7.691	8.553	10.278	12.002	13.727	15.451	17.176	.0719	.862	78
4.323	5.201	6.080	6.959	7.838	8.717	10.475	12.233	13.990	15.748	17.506	.0732	.879	79
4.404	5.299	6.195	7.090	7.986	8.882	10.673	12.464	14.256	16.047	17.838	.0747	.896	80
4.486	5.398	6.311	7.223	8.136	9.048	10.873	12.698	14.523	16.348	18.173	.0760	.912	81
4.568	5.497	6.427	7.356	8.285	9.215	11.074	12.933	14.791	16.650	18.509	.0775	.929	82
4.650	5.596	6.543	7.489	8.436	9.382	11.275	13.168	15.061	16.954	18.846	.0789	.946	83
4.733	5.697	6.661	7.624	8.588	9.551	11.479	13.406	15.333	17.260	19.187	.0803	.964	84
4.816	5.797	6.778	7.759	8.740	9.721	11.682	13.644	15.606	17.567	19.529	.0817	.981	85
4.901	5.899	6.897	7.895	8.894	9.892	11.888	13.885	15.881	17.877	19.874	.0832	.998	86
4.986	6.002	7.017	8.033	9.04[illegible]	10.064	12.096	14.127	16.159	18.190	20.221	.0846	1.016	87
5.071	6.105	7.138	8.171	9.204	10.238	12.304	14.371	16.438	18.504	20.571	.0861	1.033	88
5.157	6.208	7.259	8.310	9.361	10.412	12.514	14.616	16.718	18.820	20.922	.0876	1.051	89
5.243	6.312	7.380	8.449	9.518	10.586	12.724	14.861	16.999	19.136	21.273	.0891	1.069	90
5.329	6.416	7.503	8.589	9.676	10.762	12.936	15.109	17.282	19.455	21.628	.0906	1.087	91
5.416	6.521	7.626	8.730	9.835	10.939	13.149	15.358	17.567	19.776	21.985	.0921	1.105	92
5.504	6.627	7.750	8.872	9.995	11.117	13.363	15.608	17.853	20.098	22.343	.0935	1.123	93
5.592	6.733	7.873	9.014	10.155	11.295	13.577	15.858	18.140	20.421	22.702	.0951	1.141	94

Discharges in second-feet, rectangular

Head			Length of weir.											
Inches	Feet	4 in.	6 in.	9 in.	12 in.	15 in.	18 in.	24 in.	2 ft. 6 in.	3 ft.	3 ft. 6 in.	4 ft.	4 ft. 6 in.
95	5 1/4 0.495				1.044	1.334	1.624	2.203	2.783	3.362	3.942	4.521	5.101
96	8 .500				1.060	1.354	1.649	2.237	2.826	3.415	4.003	4.592	5.181
97	9 1/8 .505					1.374	1.673	2.271	2.869	3.467	4.065	4.662	5.260
98	9 1/4 .510					1.394	1.697	2.304	2.912	3.519	4.126	4.733	5.340
99	9 3/8 .515					1.414	1.722	2.339	2.955	3.572	4.188	4.805	5.421
100	9 1/2 .521					1.434	1.747	2.372	2.999	3.624	4.250	4.876	5.502
101	9 5/8 .526					1.455	1.772	2.407	3.043	3.678	4.313	4.948	5.584
102	9 3/4 .531					1.475	1.798	2.442	3.087	3.732	4.377	5.021	5.666
103	9 7/8 .536					1.495	1.822	2.476	3.131	3.785	4.439	5.093	5.747
104	10 .542					1.516	1.848	2.511	3.175	3.839	4.503	5.166	5.830
105	10 1/8 .547					1.537	1.873	2.547	3.220	3.893	4.567	5.240	5.913
106	10 1/4 .552					1.557	1.898	2.581	3.264	3.947	4.630	5.313	5.996
107	10 3/8 .557					1.577	1.924	2.616	3.309	4.002	4.695	5.387	6.080
108	10 1/2 .563					1.598	1.949	2.652	3.354	4.057	4.759	5.461	6.164
109	10 5/8 .568					1.619	1.975	2.687	3.400	4.112	4.824	5.536	6.248
110	10 3/4 .573					1.640	2.001	2.723	3.445	4.167	4.889	5.611	6.333
111	10 7/8 .578					1.661	2.027	2.759	3.491	4.223	4.955	5.686	6.418
112	11 .583					1.682	2.053	2.795	3.536	4.278	5.020	5.762	6.504
113	11 1/8 .589					1.703	2.079	2.830	3.582	4.334	5.086	5.837	6.589
114	11 1/4 .594					1.725	2.106	2.867	3.628	4.391	5.153	5.914	6.676
115	11 3/8 .599					1.746	2.132	2.904	3.675	4.447	5.219	5.991	6.763
116	11 1/2 .604					1.767	2.158	2.940	3.722	4.504	5.286	6.067	6.849
117	11 5/8 .609					1.788	2.184	2.976	3.768	4.560	5.352	6.144	6.936
118	11 3/4 .615					1.809	2.210	3.012	3.815	4.617	5.419	6.221	7.023
119	11 7/8 .620					1.830	2.236	3.049	3.861	4.674	5.486	6.298	7.111
120	12 .625					1.851	2.263	3.085	3.908	4.731	5.554	6.376	7.199
121	12 1/8 .630						2.290	3.123	3.956	4.789	5.622	6.455	7.288
122	12 1/4 .635						2.316	3.160	4.003	4.846	5.690	6.533	7.376
123	12 3/8 .641						2.343	3.196	4.050	4.904	5.758	6.611	7.465
124	12 1/2 .646						2.370	3.234	4.098	4.963	5.827	6.691	7.555
125	12 5/8 .651						2.397	3.271	4.146	5.021	5.895	6.770	7.645
126	12 3/4 .656						2.423	3.308	4.193	5.079	5.964	6.849	7.734
127	12 7/8 .661						2.451	3.346	4.242	5.138	6.034	6.929	7.825
128	13 .667						2.477	3.384	4.290	5.196	6.103	7.009	7.915
129	13 1/8 .672						2.505	3.422	4.339	5.256	6.173	7.090	8.007
130	13 1/4 .677						2.532	3.459	4.387	5.315	6.242	7.170	8.098
131	13 3/8 .682						2.559	3.498	4.436	5.374	6.313	7.251	8.189
132	13 1/2 .688						2.586	3.535	4.484	5.433	6.383	7.332	8.281
133	13 5/8 .693						2.614	3.574	4.534	5.494	6.454	7.414	8.374
134	13 3/4 .698						2.642	3.613	4.583	5.554	6.525	7.496	8.467
135	13 7/8 .703						2.669	3.650	4.632	5.614	6.596	7.577	8.559
136	14 .708						2.697	3.689	4.682	5.674	6.667	7.660	8.652
137	14 1/8 .714						2.725	3.728	4.732	5.735	6.739	7.742	8.746
138	14 1/4 .719						2.752	3.766	4.781	5.795	6.810	7.824	8.839
139	14 3/8 .724						2.780	3.805	4.831	5.856	6.882	7.908	8.933
140	14 1/2 .729						2.808	3.844	4.881	5.918	6.955	7.991	9.028
141	14 5/8 .735						2.836	3.884	4.932	5.979	7.027	8.075	9.123
142	14 3/4 .740						2.863	3.922	4.981	6.040	7.099	8.158	9.217
143	14 7/8 .745						2.891	3.961	5.032	6.102	7.172	8.242	9.312
144	15 .750						2.919	4.001	5.082	6.164	7.245	8.327	9.408

weirs with end contractions—Continued.

Length of weir—Continued.											Addition for increase of length.		
5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	1 in.	1 ft.	
5.680	6.839	7.998	9.157	10.316	11.475	13.793	16.111	18.429	20.747	23.065	0.0966	1.159	95
5.769	6.947	8.124	9.301	10.478	11.656	14.010	16.365	18.720	21.074	23.429	.0981	1.177	96
5.858	7.054	8.250	9.446	10.641	11.837	14.229	16.620	19.012	21.404	23.795	.0997	1.196	97
5.948	7.162	8.376	9.591	10.805	12.020	14.448	16.877	19.306	21.735	24.164	.101	1.214	98
6.038	7.271	8.504	9.737	10.970	12.203	14.669	17.135	19.601	22.067	24.533	.103	1.233	99
6.128	7.380	8.631	9.883	11.135	12.386	14.890	17.393	19.897	22.400	24.903	.104	1.252	100
6.219	7.490	8.760	10.031	11.301	12.572	15.113	17.654	20.195	22.736	25.277	.106	1.271	101
6.311	7.600	8.889	10.179	11.468	12.758	15.336	17.915	20.494	23.073	25.652	.107	1.289	102
6.402	7.710	9.018	10.327	11.635	12.944	15.560	18.177	20.794	23.411	26.028	.109	1.308	103
6.494	7.822	9.149	10.477	11.804	13.132	15.787	18.442	21.097	23.752	26.407	.111	1.328	104
6.587	7.934	9.280	10.627	11.974	13.320	16.014	18.707	21.401	24.094	26.787	.112	1.347	105
6.679	8.045	9.411	10.777	12.143	13.509	16.241	18.973	21.705	24.437	27.169	.114	1.366	106
6.773	8.158	9.543	10.929	12.314	13.700	16.470	19.241	22.012	24.783	27.554	.115	1.385	107
6.866	8.271	9.676	11.081	12.485	13.890	16.700	19.509	22.319	25.129	27.938	.117	1.405	108
6.961	8.385	9.809	11.234	12.658	14.083	16.931	19.780	22.629	25.478	28.327	.119	1.424	109
7.055	8.500	9.944	11.388	12.832	14.276	17.164	20.052	22.941	25.829	28.717	.120	1.444	110
7.150	8.614	10.078	11.542	13.005	14.469	17.397	20.324	23.252	26.180	29.107	.122	1.464	111
7.245	8.729	10.213	11.696	13.180	14.663	17.631	20.598	23.565	26.532	29.499	.124	1.484	112
7.341	8.845	10.348	11.852	13.355	14.859	17.866	20.873	23.880	26.887	29.894	.125	1.504	113
7.438	8.962	10.485	12.009	13.532	15.056	18.103	21.150	24.197	27.244	30.291	.127	1.524	114
7.534	9.078	10.622	12.165	13.709	15.252	18.340	21.427	24.514	27.601	30.688	.129	1.544	115
7.631	9.195	10.759	12.323	13.886	15.450	18.578	21.705	24.833	27.961	31.088	.130	1.564	116
7.728	9.313	10.897	12.481	14.065	15.649	18.817	21.985	25.154	28.322	31.490	.132	1.584	117
7.826	9.430	11.034	12.639	14.243	15.848	19.056	22.265	25.474	28.683	31.892	.134	1.604	118
7.923	9.548	11.173	12.798	14.422	16.047	19.297	22.546	25.796	29.046	32.295	.135	1.625	119
8.022	9.667	11.312	12.958	14.603	16.249	19.539	22.830	26.121	29.412	32.703	.137	1.645	120
8.121	9.787	11.453	13.119	14.785	16.451	19.783	23.115	26.447	29.779	33.111	.139	1.666	121
8.220	9.907	11.593	13.280	14.967	16.653	20.027	23.400	26.774	30.147	33.520	.141	1.687	122
8.319	10.027	11.734	13.442	15.149	16.857	20.272	23.687	27.102	30.517	33.932	.142	1.708	123
8.419	10.148	11.876	13.604	15.332	17.061	20.517	23.974	27.431	30.887	34.344	.144	1.728	124
8.519	10.269	12.018	13.767	15.516	17.266	20.764	24.263	27.762	31.260	34.759	.146	1.749	125
8.619	10.390	12.160	13.930	15.700	17.471	21.011	24.552	28.093	31.633	35.174	.148	1.770	126
8.721	10.512	12.303	14.095	15.886	17.678	21.260	24.843	28.426	32.009	35.592	.149	1.791	127
8.821	10.634	12.447	14.259	16.072	17.884	21.510	25.135	28.760	32.385	36.010	.151	1.813	128
8.924	10.758	12.591	14.425	16.259	18.093	21.761	25.429	29.097	32.764	36.432	.153	1.834	129
9.025	10.881	12.736	14.591	16.446	18.312	22.012	25.723	29.434	33.144	36.855	.155	1.855	130
9.128	11.005	12.881	14.758	16.635	18.511	22.265	26.018	29.772	33.525	37.278	.156	1.877	131
9.230	11.128	13.026	14.924	16.823	18.721	22.517	26.314	30.110	33.906	37.703	.158	1.898	132
9.334	11.254	13.173	15.093	17.013	18.933	22.773	26.613	30.453	34.292	38.132	.160	1.920	133
9.437	11.379	13.321	15.262	17.204	19.145	23.029	26.912	30.795	34.678	38.561	.162	1.942	134
9.541	11.504	13.467	15.431	17.394	19.358	23.284	27.211	31.138	35.065	38.992	.164	1.963	135
9.645	11.630	13.615	15.600	17.586	19.571	23.541	27.512	31.482	35.452	39.423	.165	1.985	136
9.749	11.757	13.764	15.771	17.778	19.785	23.799	27.813	31.828	35.842	39.856	.167	2.007	137
9.853	11.883	13.912	15.941	17.970	19.999	24.057	28.115	32.174	36.232	40.290	.169	2.029	138
9.959	12.010	14.061	16.112	18.164	20.215	24.317	28.420	32.522	36.624	40.727	.171	2.051	139
10.065	12.138	14.211	16.285	18.358	20.432	24.578	28.725	32.872	37.019	41.166	.173	2.073	140
10.171	12.267	14.362	16.578	18.554	20.649	24.841	29.032	33.224	37.415	41.606	.175	2.096	141
10.276	12.394	14.512	16.630	18.748	20.866	25.102	29.338	33.574	37.810	42.046	.177	2.118	142
10.383	12.523	14.663	16.804	18.944	21.085	25.365	29.646	33.927	38.208	42.489	.178	2.140	143
10.490	12.653	14.815	16.978	19.141	21.304	25.630	29.956	34.282	38.607	42.933	.180	2.163	144

Discharges in second-feet, rectangular

	Head		Length of weir.											
	Inches	Feet	4 in.	6 in.	9 in.	12 in.	15 in.	18 in.	24 in.	2 ft. 6 in.	3 ft.	3 ft. 6 in.	4 ft.	4 ft. 6 in.
145	9 3/16	0.755	.....	.....	.....	.....	.....	.....	4.040	5.133	6.226	7.319	8.411	9.504
146	9 1/4	.760	.....	.....	.....	.....	.....	.....	4.080	5.184	6.288	7.392	8.496	9.600
147	9 5/16	.765	.....	.....	.....	.....	.....	.....	4.120	5.235	6.351	7.466	8.581	9.697
148	9 3/8	.771	.....	.....	.....	.....	.....	.....	4.160	5.286	6.413	7.540	8.667	9.794
149	9 7/16	.776	.....	.....	.....	.....	.....	.....	4.199	5.338	6.476	7.614	8.753	9.891
150	9 1/2	.781	.....	.....	.....	.....	.....	.....	4.239	5.389	6.539	7.689	8.839	9.988
151	9 9/16	.786	.....	.....	.....	.....	.....	.....	4.280	5.441	6.602	7.763	8.925	10.086
152	9 5/8	.792	.....	.....	.....	.....	.....	.....	4.320	5.492	6.665	7.838	9.011	10.184
153	9 11/16	.797	.....	.....	.....	.....	.....	.....	4.360	5.544	6.729	7.913	9.097	10.282
154	9 3/4	.802	.....	.....	.....	.....	.....	.....	4.400	5.596	6.792	7.988	9.184	10.380
155	9 13/16	.807	.....	.....	.....	.....	.....	.....	4.440	5.648	6.856	8.064	9.271	10.479
156	9 7/8	.812	.....	.....	.....	.....	.....	.....	4.482	5.701	6.921	8.140	9.359	10.579
157	9 15/16	.818	.....	.....	.....	.....	.....	.....	4.522	5.754	6.985	8.216	9.447	10.678
158	9 7/8	.823	.....	.....	.....	.....	.....	.....	4.563	5.806	7.049	8.292	9.534	10.777
159	9 15/16	.828	.....	.....	.....	.....	.....	.....	4.604	5.858	7.113	8.368	9.623	10.877
160	10	.833	.....	.....	.....	.....	.....	.....	4.644	5.911	7.177	8.444	9.711	10.977

weirs with end contractions—Continued.

Length of weir—Continued.											Addition for increase of length.		
5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	1 in.	1 ft.	
10.597	12.782	14.967	17.153	19.338	21.534	25.894	30.265	34.636	39.007	43.378	0.182	2.185	145
10.704	12.913	15.121	17.329	19.537	21.745	26.161	30.577	34.994	39.410	43.826	.184	2.208	146
10.812	13.043	15.274	17.505	19.735	21.966	26.428	30.889	35.351	39.813	44.274	.186	2.231	147
10.920	13.174	15.428	17.681	19.935	22.188	26.696	31.203	35.710	40.217	44.724	.188	2.254	148
11.029	13.306	15.582	17.859	20.135	22.412	26.965	31.518	36.071	40.624	45.177	.190	2.277	149
11.138	13.438	15.737	18.037	20.336	22.636	27.235	31.834	36.433	41.032	45.631	.192	2.300	150
11.247	13.570	15.892	18.215	20.537	22.860	27.505	32.150	36.795	41.440	46.085	.194	2.323	151
11.356	13.702	16.048	18.393	20.739	23.084	27.776	32.467	37.158	41.849	46.540	.196	2.346	152
11.466	13.835	16.204	18.573	20.941	23.310	28.048	32.785	37.523	42.261	46.998	.197	2.369	153
11.576	13.969	16.361	18.753	21.145	23.537	28.321	33.105	37.890	42.674	47.458	.199	2.392	154
11.687	14.102	16.517	18.933	21.348	23.764	28.594	33.425	38.256	43.087	47.918	.201	2.415	155
11.798	14.237	16.676	19.145	21.553	23.992	28.870	33.747	38.625	43.503	48.380	.203	2.439	156
11.909	14.372	16.834	19.296	21.758	24.221	29.145	34.070	38.995	43.919	48.844	.205	2.462	157
12.020	14.506	16.992	19.478	21.963	24.449	29.421	34.392	39.364	44.336	49.307	.207	2.486	158
12.132	14.642	17.151	19.661	22.170	24.680	29.699	34.718	39.737	44.756	49.775	.209	2.510	159
12.244	14.777	17.310	19.843	22.377	24.910	29.976	35.043	40.109	45.175	50.242	.211	2.533	160

RAINFALL TABLES.

The following records of precipitation are arranged alphabetically by counties:

Record of precipitation at Tamarack, Alpine County.

[Latitude, 38° 37′; longitude, 119° 58′; elevation, 8,030 feet. Authority, P. C. Huntington.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1898-1899							12.80	2.50	1.75	0.00	0.00	0.00	[a]17.05
1899-1900	0.00	6.10	1.25	8.10	3.00	2.85	6.65	4.60	0.65	0.00	0.00	0.00	36.20
1900-1901	0.00	3.30	8.50	2.05	13.65	15.90	4.30	6.40	.95	0.39	T.	3.17	58.71
1901-1902	1.60	2.69	3.22	2.38	3.37	13.00	11.35	4.60	1.68	0.00	0.00	0.00	43.89
3 year mean													46.27

[a] Year incomplete.

Record of precipitation at Jackson, Amador County.

[Latitude, 38° 21′; longitude, 120° 45′; elevation, 1,975 feet. Authority, Richard Webb.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Total.
1877-78	0	0.70	2.00	1.45	8.45	13.04	5.55	1.97	0.24	0.04	0	0	33.44
1878-79	0.05	.97	.86	.70	5.56	5.26	6.97	4.97	2.19	.25	0	0	27.78
1879-80	0	2.92	4.33	5.38	2.30	3.44	3.51	13.59	2.41	0	0	0	37.88
1880-81	0	.15	.60	10.47	8.86	4.77	2.11	2.96	0	.05	0	0	29.97
1881-82	.58	1.38	1.82	5.32	3.86	3.89	7.71	3.72	.49	.10	0	0	28.87
1882-83	.75	5.62	3.34	1.44	3.61	1.95	3.85	2.25	4.63	0	0	0	27.44
1883-84	.90	1.43	1.48	1.59	4.02	8.58	9.41	7.65	.99	1.85	0	0	37.90
1884-85	.26	1.70	.10	14.64	1.89	.27	.26	1.34	.15	.59	0	0	21.20
1885-86	.23	0	12.80	2.78	7.97	.75	4.54	8.04	0	0	.01	0	37.12
1891-92			1.08	8.03	3.21	3.03	4.89	2.70	3.85	.46	0		[a]27.25
1892-93	.10		7.48	5.52						0	.04	0	[a]13.44
1893-94	1.34	.50	5.28	3.35	9.88	10.81	2.52	1.38	4.15	1.48	T.	T.	40.72
1894-95	1.10	3.68	1.10	15.50	12.04	6.22	3.86	3.92	2.68	0	.07	T.	50.17
1895-96	1.14	.28	.93	3.67	8.79	.43	5.18	10.89	2.11	0	.04	0.18	33.64
1896-97	.23	1.35	8.78	1.61	4.77	5.04	7.66	1.46	.03	1.10	0	.12	35.15
1897-98	.19	3.05	2.25	3.18	1.47	4.91	1.18	1.11	1.64	.43	0	0	19.41
1898-99	.10	1.04	2.11	2.70	5.20	.57	14.69	1.49	1.07	1.00	0	.07	30.25
1899-1900	0	5.86	5.81	7.45	2.37	2.15	4.37	3.52	1.83	.06	0	0	33.42
1900-1901	.11	2.74	8.32	2.24	7.13	11.24	2.58	3.83	1.18	.08	T.	T.	39.74
1901-2	3.39	2.62	3.64	3.22	1.25	9.36	4.37	2.71	1.99	.15	0	T.	32.70
18 year mean					3.82								33.16

[a] Year incomplete

Record of precipitation at Cherokee, Butte County.

[Latitude, 39° 38′; longitude, 121° 34′; elevation, 1,200 feet. Authority, L. Glass.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1871-72	0	2.95	5.41	10.09	10.58	12.25	2.33	3.11	0.45	0.56	0	0	47.73
1872-73	0	0	3.89	8.46	3.21	9.18	.59	2.14	.88	0	0	0	28.35
1873-74	0	.94	5.02	16.48	9.79	6.74	7.36	3.57	1.58	.11	0	0	51.59
1874-75	0	4.65	14.28	.43	10.84	.38	1.90	1.16	.65	1.04	0	0	35.34
1875-76	0	.24	10.41	6.96	8.48	11.95	13.36	2.66	.23	0	1.19	0	55.48
1876-77	.25	10.19	.....	.....	7.70	3.10	3.84	.75	1.51	1.28	.....	.....	[a]28.62
1877-78	0	1.72	4.32	3.60	19.63	20.00	8.87	3.53	1.14	.60	.10	.45	63.96
1878-79	1.52	2.09	2.39	.69	8.26	9.09	18.23	5.66	3.66	.35	0	.28	52.22
1879-80	2.60	4.20	12.64	3.88	3.16	2.20	18.07	2.79	0	0	0	0	49.54
1880-81	0	0	.42	16.84	14.95	7.31	2.34	1.49	1.16	0	0	0	44.51
1881-82	.90	2.92	.39	6.79	4.04	8.32	6.47	4.59	0	0	0	0	34.42
1882-83	1.31	3.23	4.65	3.72	1.42	1.31	8.10	3.12	6.98	0	0	0	33.84
1883-84	0	5.21	1.06	1.17	6.69	6.16	11.89	9.27	.80	3.87	0	0	46.12
12-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45.26

[a] Year incomplete.

Record of precipitation at Cherokee Reservoir, Butte County.

[Latitude, 39° 38′; longitude, 121° 33′; elevation, 1,200 feet. Authority, L. Glass.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1873-74	0	0	5.80	18.25	13.07	8.15	10.78	4.83	1.03	0	0	0	61.91
1874-75	0	5.99	16.99	1.15	12.47	.61	3.76	.10	1.10	2.00	0	0	44.17
1875-76	0	1.00	15.20	11.26	11.03	13.08	15.94	3.48	1.00	0	1.00	.73	73.72
1876-77	1.28	12.90	0	0	11.10	3.62	6.62	1.62	2.53	1.87	.80	0	42.34
1877-78	0	2.22	5.70	3.98	23.54	24.00	12.01	4.98	1.67	0	0	.68	78.78
1878-79	1.98	2.40	3.12	0	8.89	10.28	21.06	7.68	5.06	.50	0	0	60.97
6-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60.32

Record of precipitation at Fouts Springs, Colusa County.

[Latitude, 39° 20′; longitude, 122° 40′; elevation 1,650 feet. Authority, John F. Fouts and S. E. Stites.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1885-86	(0.00)	0.20	19.43	4.85	9.29	2.00	1.65	5.01	0.50	T.	0	0	42.93
1886-87	0	.70	.20	2.83	2.00	7.88	2.12	1.66	T.	T.	T.	0	17.39
1887-88	T.	0	1.25	4.35	10.83	.70	5.00	(3.33)	2.14	0.65	(0.00)	(0.00)	28.25
1892-93	.....	.....	.....	.....	2.08	7.11	5.17	1.95	.....	.....	.....	.....	[a]16.31
1900-1901	.....	.....	.....	5.41	12.57	4.06	.....	.79	.....	.....	.....	.....	[a]22.83
3-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29.52

[a] Year incomplete.

Record of precipitation at Little Stony, Colusa County.

[Latitude, 39° 25′; longitude, 122° 30′; elevation, ——feet. Authority, C. M. Polley.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1884-85	.....	.....	.....	8.40	1.29	1.04	0	1.38	0	1.19	0	0	[a]13.30
1885-86	0	0.27	13.29	3.51	3.44	0	1.10	3.89	.....	.....	.....	.....	[a]25.59

[a] Year incomplete.

Record of precipitation at Mount Diablo, Contra Costa County.

[Latitude, 37° 53′; longitude, 121° 54′; elevation, 3,848 feet. Authority, Pacific Railway system. J. S. Hall.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1874-75	.....	.....	.....	.....	.....	0	0.63	T.	0.33	0.62	0	0	[a]1.58
1875-76	0.00	0.18	9.19	3.11	5.60	4.95	6.23	0.65	(.39)	(.33)	.03	0	30.66
1876-77	T.	2.95	.27	0	4.63	1.89	1.11	.02	.45	.03	0	0	11.35
2-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21.01

[a] Year incomplete.

Record of precipitation at Eldorado, Eldorado County.

[Latitude, 38° 41′; longitude, 120° 51′; elevation, 1,609 feet. Authority, Pacific Railway system.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888-89	.....	.....	.....	4.00	0.31	0.38	8.41	1.60	7.50	0.12	0	0	[a]22.32
1889-90	0	7.46	6.32	14.94	12.48	5.67	10.04	3.00	3.45	0	0	.01	63.37
1890-91	1.77	.10	0	5.48	1.07	6.93	6.71	3.52	.93	.95	0	0	27.46
1891-92	.09	.85	1.08	9.09	3.48	5.75	7.24	3.61	4.91	.15	0	0	36.25
1892-93	.08	2.04	7.80	10.33	5.40	2.56	8.02	3.13	1.51	0	0	0	40.87
1893-94	1.14	.65	4.58	4.26	8.74	11.90	2.25	1.63	3.98	1.00	0	0	40.13
1894-95	.67	3.52	1.05	14.37	14.25	4.18	3.94	4.06	2.34	0	0	0	48.38
1895-96	1.41	0	.78	3.79	13.82	.15	7.80	9.56	2.59	0	0	.03	39.93
1896-97	.41	1.00	9.49	3.62	3.51	4.50	7.63	1.65	.23	.55	0	0	32.59
1897-98	.17	2.54	2.21	2.88	1.43	2.19	.86	.53	2.67	.60	0	0	16.08
1898-99	.37	.95	2.45	2.70	4.60	.57	13.10	1.02	1.80	1.57	0	.06	29.19
1899-1900	0	7.18	6.19	6.73	3.87	1.99	5.15	3.40	1.70	0	0	0	36.21
1900-1901	.10	3.26	8.11	2.23	6.90	8.73	1.69	5.54	.89	0	0	0	37.45
1901-2	2.41	1.89	2.91	3.40	1.11	10.75	4.31	2.46	.82	.62	0	0	30.68
13-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.81

[a] Year incomplete.

Record of precipitation at Georgetown, Eldorado County.

[Latitude, 38° 54′; longitude, 120° 50′; elevation, 2,500 feet. Authority, C. M. Fitzgerald.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1872–73	0	0	4.30	18.72	4.08	13.05	3.05	3.11	0.12	0	0.03	0	46.46
1873–74	0	0.61	.55	16.60	16.66	8.03	13.87	5.80	1.32	.20	0	0	63.64
1874–75	0	3.86	14.60	1.24	17.87	.04	5.07	.31	2.03	2.06	0	0	47.08
1875–76	0	1.90	24.12	10.85	13.09	9.97	14.54	4.78	1.22	0	.77	0	81.24
1876–77	0	11.47	.80	0	12.44	2.14	7.78	1.74	3.87	.24	0	0	40.48
1877–78	0	1.03	4.30	1.97	16.21	22.78	10.92	2.99	.99	.12	0	0	61.31
1878–79	.66	2.56	2.66	.48	11.24	12.41	17.57	9.65	3.39	.34	0	0	60.96
1879–80	0	3.85	6.25	11.73	5.47	6.00	5.50	25.63	5.97	0	0	0	70.40
1880–81	0	.18	.37	22.67	20.83	12.85	3.84	2.40	.40	2.28	0	0	65.82
1881–82	2.03	4.23	3.30	10.32	8.59	5.88	10.44	7.11	2.06	.18	0	0	54.14
1882–83	.16	7.75	7.00	3.31	4.70	3.08	8.73	3.87	7.34	0	0	0	45.94
1883–84	1.60	4.10	1.94	3.50	7.53	13.80	19.94	15.07	1.52	3.65	0	.01	72.66
1884–85	.80	3.54	.03	33.73	4.37	.82	.24	3.98	.19	2.28	.03	0	50.01
1885–86	1.16	0	20.77	7.03	18.32	1.16	7.75	15.04	1.76	.06	0	0	73.05
1886–87	0	3.43	1.79	6.90	3.36	15.79	2.40	6.54	.93	.18	0	0	41.32
1887–88	.53	0	1.44	7.66	14.21	3.14	6.02	1.18	.38	1.56	.04	0	36.16
1888–89	.41	0	4.67	7.99	.66	.68	12.29	2.77	7.07	.25	0	0	36.79
1889–90	0	10.45	1.23	22.94	19.90	8.96	14.70	3.86	4.66	.10	0	0	86.80
1890–91	2.81	.19	T.	7.65	.06	10.39	10.00	3.79	2.71	2.22	.42	0	40.24
1891–92	.17	1.80	1.59	3.74	5.48	8.44	7.90	7.47	7.58	.38	T	0	44.55
1892–93	.57	3.11	13.31	15.76	8.44	8.20	17.69	6.34	1.51	0	T	T.	74.93
1893–94	2.06	1.60	10.94	7.19	13.89	16.25	4.74	2.40	5.25	1.61	T.	.20	66.13
1894–95	1.26	6.22	1.53	20.93	20.52	7.69	4.67	4.77	4.30	0	.03	.07	71.99
1895–96	2.64	.20	2.18	7.27	19.55	.77	11.28	16.51	4.81	0	.20	.10	65.51
1896–97	.83	1.76	17.18	6.37	4.83	18.26	13.65	2.40	.20	1.00	0	.04	66.52
1897–98	.30	4.25	4.09	5.57	2.13	8.83	1.80	.92	2.78	1.23	0	T.	31.90
1898–99	.53	2.22	4.34	3.35	8.59	.61	21.39	1.60	2.32	1.61	0	.14	46.70
1899–1900	0	9.87	10.33	11.91	5.07	4.29	6.65	5.46	1.88	.13	.08	0	55.67
1900–1901	1.00	5.49	8.99	4.16	10.40	13.70	2.78	6.48	.99	0	T.	T.	53.99
1901–2	4.50	3.32	4.72	5.51	1.92	16.95	6.47	3.69	1.44	.56	0	.05	49.13
30-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56.72

Record of precipitation at Placerville, Eldorado County.

[Latitude, 38° 44'; longitude, 122° 48'; elevation, 2,109 feet. Authority, G. M. Barlow and Pacific Railway system.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1873-74	0	0	0	0	12.58	4.72	10.77	3.92	1.96	0	0	0	33.95
1874-75	0	3.42	9.59	1.18	12.58	.08	2.88	.61	1.58	1.84	0	0	33.76
1875-76	0	1.20	17.64	6.75	10.79	8.01	11.86	3.60	1.40	0	0.49	0.07	61.81
1876-77	10.02	6.16	.78	0	10.54	1.17	0	4.00	0	0	0	0	22.67
1877-78	.66	.99	2.25	1.55	10.45	11.73	6.53	1.80	1.67	.05	.02	.02	37.72
1878-79	.92	1.50	2.04	.41	7.75	8.00	9.38	6.25	2.48	.33	.02	.02	38.70
1879-80	0	3.47	5.28	7.53	5.04	6.58	5.96	17.92	4.43	0	0	0	56.21
1880-81	0	.35	.58	16.94	15.53	7.01	3.38	2.36	0	1.89	0	0	48.04
1881-82	1.08	2.80	2.87	7.70	6.71	5.15	9.30	5.53	1.19	.13	0	0	42.46
1882-83	.93	5.72	4.94	1.98	3.74	2.58	6.88	3.54	6.25	0	0	0	36.56
1883-84	1.67	3.38	1.67	2.63	6.06	11.56	14.46	11.82	1.60	2.51	0	.03	57.39
1884-85	.85	2.47	.10	22.65	4.15	.97	.33	3.32	.27	1.42	0	0	36.53
1885-86	.55	0	15.97	5.22	13.03	1.15	5.22	11.75	1.24	.50	T.	0	54.63
1886-87	0	1.42	.91	5.02	3.18	14.18	2.09	5.71	.53	.28	0	0	33.32
1887-88	.58	.06	1.12	8.34	11.27	2.39	5.26	.91	1.10	1.50	.04	T.	32.87
1888-89	.88	T.	5.98	7.06	1.03	.86	9.78	1.93	8.05	.16	0	T.	35.73
1889-90	0	9.07	7.77	18.18	14.57	7.46	13.81	3.36	4.01	0	0	T.	78.23
1890-91	1.64	T.	T.	6.89	1.40	9.13	7.82	3.62	1.23	.85	.05	0	24.10
1891-92	.45	.50	1.48	12.57	4.43	6.83	8.25	4.33	5.35	0	0	0	44.20
1892-93	.20	2.23	12.14	15.48	7.94	7.52	12.29	4.83	1.34	0	T.	0	63.97
1893-94	1.40	.95	6.19	5.20	11.55	14.40	3.31	2.35	4.55	1.39	T.	0	51.29
1894-95	1.35	4.25	1.20	19.03	17.85	5.07	4.43	4.75	2.58	0	T	T.	60.51
1895-96	1.79	.16	.77	5.24	16.38	.78	11.11	12.00	3.56	0	.03	.15	51.97
1896-97	.63	1.51	11.71	4.47	4.68	14.61	9.49	2.23	.36	1.09	0	.05	50.83
1897-98	.13	3.39	2.68	2.43	1.78	6.18	1.28	.58	2.70	.66	T.	0	21.81
1898-99	.11	1.00	2.30	2.80	5.62	.48	14.98	2.01	1.78	.88	0	.10	32.06
1899-1900	0	7.73	6.72	8.32	3.92	2.89	5.84	4.32	1.15	.68	T.	0	41.57
1900-1901	.55	3.62	9.82	3.30	9.95	9.53	2.34	6.54	1.05	0	0	0	46.70
1901-2	3.13	2.12	3.74	3.58	1.35	10.15	5.33	2.73	1.35	.60	0	.14	34.22
29 year mean													43.58

Record of precipitation at Shingle Springs, Eldorado County.

[Latitude, 38° 39′; longitude, 120° 55′; elevation, 1,427 feet. Authority, M. Phelps and Pacific Railway System.]

Year.	Sept.	Oct.	Nov	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1849-50	0	0.08	5.65	10.04	13.07	2.15	6.80	0.45	0.02	0	0	0	38.26
1850-51	1.23	.10	.65	2.70	4.80	.40	2.10	4.80	.40	0	0	0	17.18
1851-52	.40	.30	2.45	7.80	3.20	.50	9.60	7.25	1.00	0	0	0	32.50
1852-53	0	.50	7.20	11.40	13.70	2.40	8.20	3.00	1.10	0.05	0	0	47.55
1853-54	1.20	.75	6.40	4.10	4.40	3.40	4.30	5.49	.20	.30	0	0	30.45
1854-55	0	3.72	2.70	3.50	3.20	1.10	2.50	2.10	.68	0	0	0	19.50
1855-56	.70	0	2.40	5.70	4.10	.80	3.40	1.20	.20	.10	0	0	18.60
1856-57	0	0	2.15	6.35	6.50	7.05	1.94	0	.42	.35	0.35	0	25.11
1857-58	0	.42	4.04	1.99	2.37	2.69	4.00	1.70	.20	.60	0	0	18.01
1858-59	0	3.25	.50	6.20	1.22	12.00	5.81	1.82	1.51	0	0	0	32.31
1859-60	0	.15	11.16	2.40	2.20	1.15	4.71	3.40	2.10	.02	.80	0	28.09
1860-61	0	1.20	.50	7.43	3.78	4.60	8.34	.20	.15	.05	0	0	26.25
1861-62	0	0	6.90	11.22	34.13	6.75	6.90	7.34	4.10	1.90	2.56	0	81.80
1862-63	0	.78	.37	2.84	1.45	4.96	4.01	2.76	2.10	0	0	0	19.27
1863-64	0	0	2.05	6.30	7.29	3.21	63	3.94	.85	0	0	0	24.27
1864-65	0	.08	9.94	9.13	5.13	5.63	1.13	2.50	.89	0	0	0	34.43
1865-66	0	.45	6.84	2.57	11.08	3.46	6.21	1.31	4.88	.18	0	0	36.98
1866-67	0	0	4.73	18.77	9.17	7.51	4.09	6.01	.01	0	0	0	50.29
1867-68	.82	2.24	7.17	23.76	12.12	3.70	14.39	.....	.....	.....	.....	.....	[a] 64.20
1885-86	.....	.....	.....	4.99	10.77	.69	3.84	9.51	.71	.....	.....	.....	[a] 30.51
1886-87	.....	1.66	.93	3.50	1.67	12.21	1.45	.....	.06	0	.....	.....	[a] 21.48
1887-88	.49	T.	1.08	6.18	8.82	1.08	4.22	.43	.18	.31	0	0	22.79
1888-89	0	0	4.45	4.45	.40	.70	9.01	1.98	7.80	0	0	0	28.79
1889-90	0	8.73	7.85	17.35	13.50	6.70	10.48	2.75	3.65	0	0	0	71.01
1890-91	1.50	.08	0	5.40	1.40	7.65	7.97	3.80	1.60	.70	0	0	30.10
1891-92	.04	.70	1.10	7.58	2.55	6.43	4.95	2.26	1.98	0	0	0	27.59
1892-93	.15	2.30	7.85	8.25	4.97	4.17	9.78	2.95	.95	0	0	0	41.37
1893-94	.85	.40	4.98	3.30	7.07	9.40	1.60	1.03	3.25	.25	0	0	32.13
1894-95	0	3.55	.99	14.50	11.33	4.48	1.98	3.20	1.70	0	0	0	41.73
1895-96	1.40	.15	2.53	3.56	14.07	.30	6.33	8.21	1.79	0	0	0	38.34
1896-97	.25	1.05	11.75	7.18	4.25	12.75	7.00	.97	.22	.30	0	0	45.72
1897-98	0	2.15	1.40	3.25	.93	3.80	.05	.40	2.10	.52	0	0	14.60
1898-99	.25	.80	1.90	3.05	4.87	.37	14.13	.60	1.28	1.25	0	.15	28.65
1899-1900	0	6.25	6.29	7.30	.....	.....	.....	.....	.....	.....	.....	.....	[a] 19.84
30-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33.46

[a] Year incomplete.

Record of precipitation at Jacinto, Glenn County.

[Latitude, 39° 35′; longitude, 122° 00′, elevation, 110 feet.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr	May	June.	July.	Aug.	Total.
1892-93	0.62	1.21	6.32	8.13	4.20	2.99	3.71	0.87	1.44	0	0	0	29.49
1893-94	.47	.06	2.67	1.61	4.50	1.47	.89	.51	1.24	0	0	0	13.42
1894-95	1.20	1.33	.35	8.69	8.73	1.86	1.74	2.49	.22	0	0.36	0	26.97
1895-96	2.33	0	1.10	.94	9.37	.24	2.92	4.03	.69	0	0	0.52	22.14
1896-97	.63	.68	3.06	5.28	3.78	3.54	1.72	.77	60	0.44	0	0	20.50
1897-98	0	2.12	1.16	1.40	.76	3.42	31	2.07	0	0	0	0	11.24
1898-99	.35	.41	0.49	1.39	6.36	0	4.29	.36	1.21	.53	0	0	15.39
1899-1900	0	2.68	4.40	3.40	3.06	.17	1.27	1.68	.72	0	0	0	17.38
1900-1901	0	2.42	5.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	[a] 7.42
8-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.57

[a] Year incomplete.

Record of precipitation at Julians, on Stony Creek, Glenn County.

[Latitude, 39° 45'; longitude, 122° 30'; elevation, 750 feet. Authority, Mrs. Lee Julian.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900-1901	.....	.....	.....	.....	.....	4.26	0.12	1.24	0.50	0	0	0	a6.12
1901-2	1.07	0.60	3.18	0.82	0.85	9.27	3.24	2.37	2.06	0	0	0	23.46

a Year incomplete.

Record of precipitation at Christmas Prairie, Humboldt County.

[Latitude, 40° 55'; longitude, 124° 00'; elevation, 3,000 feet. Authority, J. H. Blake.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1883-84	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.56	0.24	0.01	a1.81
1884-85	3.23	2.17	1.37	26.44	8.79	8.39	1.45	3.30	1.34	1.57	0	0	58.05
1885-86	.93	1.65	31.99	18.85	16.59	6.30	6.51	12.97	2.83	0	1.17	0	99.79
1886-87	0	4.72	3.93	13.73	15.97	20.92	5.00	.....	.....	.....	.....	.....	a64.27
2-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	78.92

a Year incomplete.

Record precipitation at Bishop Creek, Inyo County.

[Latitude, 37° 21'; longitude, 118° 22'; elevation, 4,450 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1883-84	0.12	0.11	0	0.38	0.62	0.64	0.94	0.05	0	0	0	0	2.86
1884-85	0	0	0	1.00	0	0	.67	.14	0	0	0	0	1.81
1885-86	0	.02	0.35	0	1.03	0	.50	.38	0	0	0	0	2.28
1886-87	0	0	0	.20	.65	1.58	0	.35	0.55	0.35	0	0	3.68
1887-88	.15	.15	.05	1.10	1.37	.47	.05	0	0	.35	0.20	0	3.89
1888-89	0	0	1.72	.40	.10	.50	1.46	.12	.30	0	0	0	4.60
1889-90	0	.03	.35	1.20	4.75	.30	0	0	0	0	0	0.50	7.13
1890-91	.69	0	0	1.00	0	3.70	.28	0	2.90	0	0	.03	8.60
1891-92	.19	0	0	3.52	.10	.70	1.10	0	.25	T.	0	0	5.86
1892-93	0	.20	1.42	2.27	1.22	1.12	.15	0	0	0	1.05	T.	7.43
1893-94	.19	0	.10	.49	.30	.75	.09	.05	T.	.35	T.	.23	2.55
1894-95	T	0	0	1.18	1.10	.50	.22	.29	.15	.11	.21	.07	3.83
1895-96	T.	.16	.15	T.	1.07	0	.60	.05	.03	0	.57	.06	2.69
1896-97	.05	T	T.	.16	.32	1.67	1.75	0	.12	T.	.01	.05	4.13
1897-98	.09	.39	T.	.49	.05	.13	T.	.21	.27	T.	T.	.06	1.69
1898-99	.41	0	.21	.11	1.65	0	T.	.64	.02	0	0	.05	3.09
1899-1900	0	.14	.05	1.05	.49	.01	.54	.60	.34	.12	T.	0	3.34
1900-1901	.39	.03	2.69	.17	4.89	1.01	T.	.50	1.29	T.	0	.93	11.90
1901-2	0	.81	.61	.12	.07	.55	1.53	.61	.06	0	T.	.12	4.48
9-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.52

a Year incomplete.

Record of precipitation at Camp Independence, Inyo County.

[Latitude, 36° 50′; longitude, 118° 10′; elevation, 4,598 feet. Authority, United States War Department.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1865–66	.....	.....	0	0.65	2.42	0	0	0.16	.....	.....	.....	.....	[a] 3.23
1866–67	0	0.32	0	2.27	0	1.63	4.76	.53	0.76	0	0.01	1.15	11.43
1867–68	0.07	.32	0.21	12.19	5.46	0	0	.40	.71	0	.10	0	19.46
1868–69	0	.74	.44	1.17	.16	0	.32	.11	.36	0	.03	0	3.33
1869–70	0	0	.14	0	.20	1.36	0	.21	.27	0	.35	.10	2.63
1870–71	0	1.10	0	1.00	0	1.28	0	0	0	.30	0	0	3.68
1871–72	0	0	.65	4.70	0	.30	.28	.55	.18	0	.28	.12	7.06
1872–73	0	0	0	1.18	0	.40	0	0	0	0	0	.05	1.63
1873–74	.10	0	0	3.40	2.40	1.00	0	0	0	.01	.15	0	7.06
1874–75	.40	.80	.40	0	1.73	0	0	0	0	0	0	0	3.33
1875–76	.01	0	.66	.62	1.51	.70	.87	0	0	.15	.19	.56	5.27
1876–77	.16	.26	0	0	.76	0	0	.59	.69	0	0	0	2.46
1891–92	.....	.....	.....	.....	.....	.....	.62	.....	.96	.07	T.	T.	[a] 1.65
1892–93	0	.35	.23	1.61	1.51	2.91	.98	.02	T.	0	.77	T.	8.38
1893–94	T.	0	.10	.75	.12	.42	.09	.02	.10	.11	.12	.51	2.34
1894–95	T.	0	0	1.89	1.24	1.18	.12	T	.01	T.	T.	.04	4.48
1895–96	T.	.83	.67	.08	.....	.....	.....	.....	.....	.....	.....	.....	[a] 1.58
1896–97	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1897–98	.....	.....	.....	.....	.....	.....	0	.16	.23	T.	T.	.11	[a] .50
1898–99	.20	0	.10	.20	.54	T.	.01	.02	.03	.37	.01	.06	1.54
1899–1900	T.	.30	.85	.56	.31	.05	.67	.62	.22	.04	.08	T.	3.70
1900–1901	.75	.01	1.34	.13	2.81	.64	.05	T.	.36	0	.10	.32	6.51
1901–2	0	.65	.22	.06	.04	1.69	1.05	.17	.04	.01	.17	.13	4.23
18-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.47

[a] Year incomplete.

Record of precipitation at Keeler, Inyo County.

[Latitude, 36° 35′; longitude, 117° 50′; elevation, 3,622 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1883–84	.....	.....	.....	.....	.....	.....	.....	0.20	1.60	0.80	0	0.20	[a] 2.80
1884–85	0	0	0	0.70	0	0	0.12	.82	0	.08	0	.11	1.83
1885–86	0	0.25	0.65	.36	0.49	0.14	.60	.40	0	0	.14	.08	3.11
1886–87	0	.01	.08	0	T.	.93	0	1.14	.04	T.	.52	0	2.72
1887–88	1.08	.84	.01	.48	.70	1.21	.30	.12	.30	.20	.17	.10	5.51
1888–89	.06	0	1.68	.82	.04	T.	.52	.12	.06	.01	0	T.	3.31
1889–90	.08	.56	.05	.56	.42	.01	T.	.10	.20	0	T.	1.71	3.69
1890–91	.93	.03	.12	.22	0	1.00	2.01	0	.37	.30	.06	.02	5.06
1891–92	.19	.04	0	.31	.26	.19	.32	0	.55	T.	0	0	1.87
1892–93	T.	.81	.11	.54	.71	.75	1.50	0	T.	0	1.41	T.	5.83
1893–94	T.	T.	.03	1.48	T.	.29	.01	T.	T.	T.	.11	0	1.92
1894–95	0	0	0	1.05	.35	1.15	T.	.25	T.	T.	T.	T.	2.80
1895–96	T.	0	0	T.	.45	0	T.	T.	.15	T.	.25	1.42	2.27
1896–97	.50	T.	0	.25	.10	.27	.13	0	T.	0	0	.19	1.44
1897–98	.14	.15	T.	T.	0	0	0	.05	0	0	0	0	.34
1898–99	T.	0	T.	.30	.40	.45	0	.01	T.	.50	T.	T.	1.66
1899–1900	0	T.	1.75	T.	T.	0	.16	1.25	.23	T.	.10	T.	3.49
1900–1901	.35	.09	.45	0	.75	.25	0	T.	.40	0	0	.90	3.19
1901–2	0	.50	0	0	T.	.25	1.25	0	0	0	T.	T.	2
18-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.89

[a] Year incomplete.

Record of precipitation at Bear Valley, Kern County.

[Latitude 35° 40'; longitude, 118° 30'; elevation, 4,000 feet. Authority, Philip Fickert, Tehachapai.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1894-95	1.48	6.38	1.25	22.37	29.22	6.64	7.42	3.25	6.57	0	0.04	0.20	84.82
1895-96	5.18	1.25	2.08	9.45	25.39	1.66	14.47	18.32	10.03	0	.72	.68	89.23
1896-97	2.13	2.57	18.35	8.02	4.18	16.05	19.12	3.35	.80	------	------	------	a74.57
1897-98	------	------	------	5.96	3	10.44	------	1.65	3.93	2	0	T.	a26.98
1898-99	.73	3.07	6.26	3.44	11.95	3.20	23.34	2.51	4	1.01	0	.93	60.44
1899-1900	0	14.16	11.91	12.81	2.77	1.34	1	5.65	2.47	0	0	0	51.51
1900-1901	0	1.76	2.71	.32	1.91	5.30	2.75	1.77	1.43	0	T.	0	17.95
1901-2	0	1.27	.56	.90	3.20	5	5.36	3.48	.75	0	0	0	20.52
6-year mean	------	------	------	------	------	------	------	------	------	------	------	------	54.08

a Year incomplete.

Record of precipitation at Caliente, Kern County.

[Latitude, 35° 17'; longitude, 118° 41'; elevation, 1,290 feet. Authority, Pacific Railway System.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1875-76	------	------	------	------	------	2.02	1.66	0.53	T.	0	0	T.	a4.21
1876-77	0	0.52	T.	0	1.08	.47	1.08	1.27	(0.52)	0	0	0	4.94
1877-78	0	0	0.84	2.31	3.81	4.47	2.69	3.20	.03	0	0	0	17.35
1878-79	0	.42	.10	.10	.20	.34	.33	1.43	.20	0.04	0	0	3.16
1879-80	0	1.08	1.77	3.46	2.37	1.51	1.09	3.53	.23	0	0	0	15.04
1880-81	0	0	0.35	3.56	1.61	1.54	1.91	.64	.23	0	0	0	9.84
1881-82	0.13	0.81	.30	.51	1.51	3.30	.73	1.59	.69	.56	0	0	10.13
1882-83	0	1.01	.69	.37	.04	1.76	.82	2.42	1.07	0	0	0	8.18
1883-84	.08	.76	.05	(1.81)	2.00	4.98	5.00	2.90	1.10	1.28	0	0	19.96
1884-85	0	.22	.25	3.25	.25	0	.45	3.00	1.05	0	0.05	0	8.52
1885-86	0	.05	3.88	1.33	1.59	.66	2.62	2.65	0	0	T.	0	12.78
1886-87	0	T.	1.45	1.33	.38	2.79	.07	2.66	.21	0	0	0	8.89
1887-88	0	.63	.05	1.43	.87	1.14	1.50	0	.81	0	0	0	6.43
1888-89	0	0	6.14	2.18	.59	.20	3.15	.60	0	0	0	0	12.86
1889-90	0	1.35	1.05	3.65	(1.25)	1.15	1.10	0	1.62	0	0	0	11.17
1890-91	.52	0	0	4.30	.19	2.83	.40	1.60	0	0	0	0	9.84
1891-92	.27	.05	T.	3.73	.75	1.00	4.25	.30	1.00	.50	0	0	11.85
1892-93	0	0	0	2.80	1.00	2.15	3.71	.70	0	0	0	0	10.36
1893-94	0	.10	.20	3.45	3.30	1.40	1.60	.20	.50	.70	0	0	11.45
1894-95	.60	.20	.25	4.39	5.28	3.10	1.67	.85	.87	0	0	0	17.21
1895-96	0	2.31	1.51	1.20	2.53	.25	3.30	1.58	.56	0	.05	.29	13.58
1896-97	0	1.00	.55	3.55	1.25	4.96	2.41	.35	.13	0	0	0	14.20
1897-98	0	.90	0	2.02	1.67	.70	1.45	.76	1.40	0	0	0	8.90
1898-99	.10	0	.45	.68	1.73	.41	3.26	.28	1.13	0	0	0	8.04
1899-1900	0	.25	1.52	.64	.50	.98	.80	1.75	2.35	0	0	0	8.79
1900-1901	0	0	2.13	0	.89	2.10	.35	1.33	1.18	0	0	0	7.98
1901-2	0	0	0	0	1.70	3.80	3.65	2.70	.11	(.12)	0	0	12.08
26-year mean	------	------	------	------	------	------	------	------	------	------	------	------	10.91

a Year incomplete.

Record of precipitation at Fort Tejon, Kern County.

[Latitude, 34° 55′; longitude, 118° 44′; elevation, 3,245 feet. Authority, United States War Department, and J. G. Stitt, Bakersfield.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1854–55	------	------	------	------	------	------	1.58	3.78	0.61	0	------	0	[a]5.97
1855–56	0.99	0.05	0	7.50	4.41	7.88	2.24	4.98	4.62	0	0	0.30	32.97
1856–57	.08	.05	3.12	6.54	.37	.95	0	.04	.63	0	.07	.12	11.97
1857–58	0	2.11	1.04	4.50	2.60	.75	7.39	5.37	.09	1.20	0	.35	25.40
1858–59	.44	2.62	.25	3.07	.29	1.69	1.22	2.37	0	0	0	.07	12.02
1859–60	8.58	.16	1.02	0	.22	.25	.20	.60	.20	.21	.01	.16	11.61
1860–61	------	------	------	------	.73	.31	.26	T.	.43	------	------	T.	[a]1.73
1861–62	------	------	------	------	------	------	------	------	------	------	------	------	------
1862–63	------	------	------	------	------	------	------	------	------	------	------	T.	------
1863–64	2.02	1.00	.71	4.32	.42	0	1.84	1.80	1.09	.04	T.	.10	13.34
1894–95	------	------	------	------	------	3.08	2.14	1.44	1.31	0	0	0	[a]7.97
1895–96	0	1.46	1.42	1.25	3.07	.40	4.01	3.33	2.05	.22	.26	.30	17.77
1896–97	.53	1.63	1.74	4.47	3.52	5.14	3.63	.95	0	0	0	0	21.61
1897–98	0	1.39	0	1.72	1.89	1.55	1.36	.40	.30	0	0	0	8.61
1898–99	.60	0	.65	.73	2.57	.50	2.99	.55	.25	.78	0	0	9.62
1899–1900	.05	1.10	1.71	1.40	2.12	.66	.85	1.82	1.57	0	0	0	11.28
1900–1901	1.06	0	1.71	.50	1.80	5.86	1.97	.78	.90	0	0	T.	14.58
1901–2	.05	1.61	.26	T.	------	------	------	------	------	------	------	------	[a]1.92
12-year mean	------	------	------	------	------	------	------	------	------	------	------	------	15.90

[a] Year incomplete.

Record of precipitation at Isabella, Kern County.

[Latitude, 35° 48′; longitude, 118° 25′; elevation, 2,600 feet. Authority, Stephen Barton, Isabella.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895–96	------	------	------	------	------	0.10	1.93	0.89	0.04	0.06	2.57	0.01	[a]5.60
1896–97	0.32	1.17	0.48	0.70	------	------	------	------	------	------	------	------	[a]2.67
1897–98	.15	0	0	1.24	0.54	.99	.58	.06	.54	0	0	0	4.10
1898–99	.04	0	0	.33	1.95	.19	1.89	.28	.25	.45	0	0	5.38
1899–1900	0	.78	.85	.78	1.10	.65	.65	.73	1.06	0	0	.02	6.62
1900–1901	.30	.24	5.53	.05	1.20	2.74	.33	.36	1.98	0	0	.99	13.72
1901–2	0	.64	.13	0	.34	6.05	2.27	1.02	.05	0	0	0	10.50
5-year mean	------	------	------	------	------	------	------	------	------	------	------	------	8.06

[a] Year incomplete.

Record of precipitation at Keene, Kern County.

[Latitude, 35° 42′; longitude, 118° 40′; elevation, 2,705 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1877-78	0	0	0	1.75	4.37	7.49	2.72	2.10	0	0	0	0	18.43
1878-79	0	0.47	0	.74	.67	.55	.83	1.97	0	0	0	0	5.23
1879-80	0	.50	1.43	5.37	2.36	1.21	1.15	4.07	0.12	0	0	0	16.21
1880-81	0	.22	.26	3.43	2.12	2.42	1.96	.72	.19	0	0	0	11.32
1881-82	0.58	.21	.96	.30	1.40	2.57	1.42	1.44	.60	0.10	0	0	9.58
1882-83	0	1.40	.25	.47	.17	3.31	2.55	2.04	.86	0	0	0	11.05
1883-84	0	.45	.16	1.06	2.14	7.46	4.80	3.16	3.23	1.79	0	0	24.25
1884-85	0	2.55	.36	5.22	.30	.13	.65	1.47	.11	.10	0.06	T.	10.95
1885-86	0	.28	3.73	.46	2.02	.64	2.93	2.84	0	T.	T.	0.02	12.92
1886-87	0	T.	1.95	1.10	.51	3.20	.92	2.73	T.	.20	T.	0	10.61
1887-88	.12	1.32	.50	1.72	1.30	1.70	2.69	.78	2.03	0	.68	0	12.84
1888-89	0	0	1.28	2.29	.36	0	3.74	.95	1.77	0	0	.28	10.67
1889-90	.42	2.23	1.30	5.17	3.15	1.97	1.98	.50	1.30	0	0	1.40	19.42
1890-91	.41	0	.10	3.57	.23	6.59	1.30	1.30	1.35	.05	0	0	14.90
1891-92	.22	0	.08	6.37	1.65	2.22	4.10	1.86	.60	1.07	0	0	18.17
1892-93	0	.16	.65	1.98	2.20	3.26	6.70	1.30	T.	0	1.05	0	17.30
1893-94	.14	.35	.18	1.50	3.60	1.65	2.25	.55	.40	.20	0	0	10.82
1894-95	.35	.05	.30	4.59	6.03	2.71	2.40	1.95	1.25	0	0	0	19.63
1895-96	0	1.37	1.65	1.90	.82	0	2.47	2.82	1.30	0	.15	.40	12.88
1896-97	0	0	1.01	2.94	2.28	7.49	3.17	.14	0	.59	0	0	17.62
1897-98	0	1.01	0	3.02	1.73	.75	2.04	.35	1.12	0	0	0	10.02
1898-99	.03	0	.40	.62	.41	1.17	4.10	.66	1.18	.79	0	0	9.36
1899-1900	0	.61	3.16	.90	.92	1.12	.54	2.57	1.55	0	0	0	11.37
1900-1901	.27	.70	1.94	0	.99	5.35	1.30	1.19	.80	0	0	.89	13.43
1901-2	0	.45	.26	.30	1.56	6.91	4.80	2.70	.45	0	0	0	17.43
25 year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.86

Record of precipitation at Kernville, Kern County.

[Latitude, 35° 45′; longitude, 118° 27′; elevation, 2,600 feet. Authority, Stephen Barton and A. Brown, Kernville.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893-94	.....	.....	.....	.....	1.10	1.88	0.42	0.17	0.53	0.	0	0.01	[a]4.11
1894-95	0.60	0	0	5.31	5.10	1.55	1.80	.37	0	0	0	0	14.73
1895-96	0	0.50	0.95	.40	3.52	0	1.54	.86	0	0.20	2.25	.05	10.27
1896-97	0	1.48	.41	.85	3.40	3.60	2.57	.10	0	0	0	0	12.41
1897-98	0	.45	1.14	11.32	.58	.99	.58	T.	.54	0	0	0	15.60
1898-99	.04	0	0	.33	1.95	.19	1.89	.28	.25	.45	0	0	5.38
1899-1900	0	.78	.85	.73	.80	.53	.58	.52	.90	0	0	0	5.69
1900-1901	.79	.10	5.09	0	1.35	2.92	.15	.31	1.62	0	0	.70	13.03
1901-2	0	.72	.15	0	.30	3.07	2.10	.74	.10	.00	.00	.00	7.18
7 year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11.02

[a] Year incomplete.

Record of precipitation at Mount Breckinridge, Hanlon, Kern County.

[Latitude, 35° 25′; longitude, 118° 35′; elevation, 6,750 feet. Authority, G. Otterman.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1896–97	.....	.....	2.26	5.95	2.70	5.12	7.72	0	0.40	0.10	0	0	[a]24.25
1897–98 [b]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1898–99	.....	.....	.....	.....	.....	1.79	3.17	.....	.....	.....	.....	.....	[a]4.96

[a] Year incomplete. [b] No record kept in 1898.

Record of precipitation at Taylor's ranch, Weldon, Kern County.

[Latitude, 35° 30′; longitude, 118° 17′; elevation, 2,640 feet. Authority, Geo. E. Carleton and Annie Alexander, Weldon.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1899–1900	.....	.....	0.78	0.66	0.71	0.47	0.50	0.39	0.82	0.02	0	0.03	[a]4.38
1900–1901	0.62	0.02	4.29	0	1.06	1.96	.05	.41	1.02	0	0	2.60	12.03
1901–2	0	.39	.12	0	.26	4.37	1.41	.31	0	0	0	0	6.86
2-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.45

[a] Year incomplete.

Record of precipitation at Tehachapai, Kern County.

[Latitude, 35° 06′; longitude, 118° 26′; elevation, 3,964 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Total.
1876–77	0.08	0.45	0	0	0.58	0.14	0.89	0.60	0.12	0	0.02	0	2.88
1877–78	0	T.	0.50	2.91	2.59	6.32	1.76	1.93	.28	0.09	0	T.	16.38
1878–79	0	.30	.04	.64	2.62	.45	.19	1.39	.09	.12	0	0	5.84
1879–80	0	.52	1.03	5.52	2.81	1.94	1.47	2.30	0	0	0	0	15.59
1880–81	0	.75	.10	2.14	1.79	2.05	3.15	.50	0	0	0	0	10.48
1881–82	.32	.10	.50	.12	1.05	2.07	1.45	.63	.20	.15	0	0	6.59
1882–83	0	.74	.18	.50	15	4.55	1.51	2.89	1.73	0	0	0	12.25
1883–84	0	.81	.14	.72	1.54	7.57	3.48	1.85	1.26	1.05	0	0	18.42
1884–85	0	.13	.29	3.96	.10	0	.26	1.48	.30	0	.05	.31	6.88
1885–86	0	0	3.70	.52	1.58	6.06	4.10	4.57	0	0	.10	0	20.63
1886–87	0	T.	1.15	.60	.50	8.88	.24	1.95	.26	0	0	0	13.58
1887–88	0	.86	.26	1.44	2.57	2.60	1.20	1.25	.25	0	0	0	10.43
1888–89	0	0	0	3.65	.40	.60	3.56	3.96	1.07	0	0	80	14.04
1889–90	0	2.70	.70	5.30	1.75	.70	.30	0	0	0	0	0	11.45
1890–91	.50	0	0	3.48	.03	3.45	.80	.90	.70	(0.00)	0	0	9.86
1891–92	1.17	0	0	3.10	.92	2.68	2.72	.61	.55	0	0	0	11.75
1892–93	0	0	0	.40	.85	3.61	5.00	.65	0	0	0	0	10.51
1893–94	0	.50	.50	5.25	2.80	1.68	0	(.18)	.32	.27	0	0	11.50
1894–95	.10	0	0	3.75	3.21	.69	1.08	.50	.75	0	0	0	10.08
1895–96	0	.44	60	.26	1.57	0	2.80	.63	0	0	0	.85	7.15
1896–97	0	1.45	.53	1.13	1.78	2.03	.18	.25	0	0	0	0	7.35
1897–98	.02	.38	0	1.00	1.20	.34	1.35	.10	.82	0	0	0	5.21
1898–99	0	0	T.	.20	.68	.60	1.62	0	.22	.38	0	0	3.70
1899–1900	0	.57	1.53	.61	.64	.39	.29	1.29	50	23	T.	0	6.05
1900–1901	0	.46	1.53	0	1.17	3.29	.25	.28	.79	0	0	1.70	9.47
1901–2	0	.50	0	0	.80	3.90	1.05	1.73	0	0	0	0	7.98
26-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.23

Record of precipitation at Tejon Ranch, Kern County.

[Latitude, 35° 01′; longitude, 118° 45′; elevation, 1,450 feet. Authority, R. M. Pogson, Bakersfield.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1894-95					5.05	1.39	1.70	1.11	.49	0	0	0	a 9.74
1895-96	0	2.13	1.41	1.06	1.90	.37	4.22	1.62	.48	0	0	0	13.19
1896-97			2.12										a 2.12
1897-98					2.32	1.68	.94	.17	.84	0	0	0	a 5.95
1898-99	0.31	.42	.55	.87	1.30	2.10	4.03	.82	0	0	0	0	10.45
1899-1900	0	1.31	1.82	1.67	1.17	.35	.41	1.97	1.57	.02	0	0	10.29
1900-1901	.06	.67	1.06	.34	1.28	4.69	.95	1.36	1.28	0	0	T.	11.69
1901-2	0	.40	.17	.60	1.61	1.46	2.74	2.02	.98	0	0	0	9.98
5-year mean													11.12

a Year incomplete.

Record of precipitation at Bartlett Springs, Lake County.

[Latitude, 39° 10′; longitude, 122° 45′; elevation, 2,375 feet. Authority, J. E. McMahon.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1896-97					3.50	6.78	5.36	0.75	0	0	0	0	a 16.39
1897-98	0	1.70	2.31	3.72	1.53	8.36	.19	.63	2.39	1.10	0	0	21.93
1898-99	0	0	1.87	1.23	13.14	0	8.49	.85	2.47	0	0	0	28.05
1899-1900	0	4.79	10.06	7.87	7.51	1.27	6.42	3.23	.88	0	0	0	42.03
1900-1901					14.59	7.62	1.67	4.52	1.40	0	0	0	a 29.80
1901-2	1.17	1.80	5.86	4.02	1.71	22.38	5.98	5.20	3.40	0	0	0	51.52
4-year mean													35.88

a Year incomplete.

Record of precipitation at Kono Tayee, Lake County.

[Latitude, 39° 5′; longitude, 122° 43′; elevation, 1,350 feet. Authority, R. S. Floyd.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1873-74	0	0	0	0	1.88	3.60	4.62	2.05	0.45	0	0	0	12.60
1874-75	0	3.50	6.25	0.29	9.16	.38	.92	0	.84	0.42	0	0	21.96
1875-76	0	1.17	6.96	5.12	6.05	4.22	8.34	.10	0	0	0	0	31.96
1876-77	0	.20	3.50	0	3.17	2.81	1.40	.50	0	.50	0	0	12.08
1877-78	0.73	1.65	2.23	1.98	14.16	11.04	4.60	1.43	0.79	.45	0	0.07	39.13
1878-79	0	.11	1.37	.33	3.01	3.41	9.15	.47	.64	0	0	.05	18.84
1879-80	0	.91	3.57	5.72	6.24	3.85	4.74	.48	.25	0	0	0	25.76
1880-81	0	0	3.51	1.92	5.50	6.58	.64	.95	.12	.25	0	0	19.50
1881-82	0	.63	2.90	1.77	1.74	3.20	2.34	1.54	.40	0	0	0	14.52
1882-83	.12	1.64	4.42	.98	1.40	.60	3.81	.95	2.41	0	0	0	16.63
1883-84	.70	.99	.39	.70	4.17	1.91	5.35	3.88	.06	4.08	0	0	22.23
1892-93	.18	.81	6.53	5.57	3.84	4.15	5.41	2.06	.66	0	0	0	29.24
1893-94	.25	.42	3.76	2.31	6.92	4.32	1.11	.91	.90	1.64	0	T.	22.57
1894-95	.50	1.22	.74	10.70	14.45	2.32	3.13	.98	1.14	0	0	T.	35.18
1895-96	.71	0	1.69	2.12	9.42	.25	2.31	4.62	1.69	.45	T.	.27	23.53
1896-97	.29	.73	3.33	5.93	2.85	4.01	3.76	.90	.90	.48	0	0	23.18
1897-98	0	1.24	1.64	2.12	.71	4.19	.11	.64	1.67	.45	0	0	12.77
1898-99	.51	.46	1.15	1.27	7.74	T.	5.43	.70	.45	.28	.18	T.	18.17
1899-1900	0	3.78	5.56	4.14	3.10	1.27	2.89	2.32	.67	T.	0	0	23.73
1900-1901	T.	3.11	3.89	1.67	5.57	4.33	1.33	2.05	.96	.45	0	T.	23.36
1901-2	.01	1.01	3.87	1.19	1.31	10.28	3.85	2.42	1.59	0	0	T.	26.09
11-year mean													22.53

Record of precipitation at Lakeport, Lake County.

[Latitude, 123° 0′; longitude, 39° 0′; elevation, 1,325 feet. Authority, D. C. Rumsey.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Total.
1900-1901	0	4.25	5.55	4.20	9.20	3.95	1.25	2.15	0.62	0	0	0	31.17
1901-2	.88	2.20	4.18	0	3.00	12.86	3.70	3.30	2.45	0	0	0	32.57
2-year mean													31.86

Record of precipitation at Middletown, Lake County.

[Latitude, 38° 46′; longitude, 122° 37′; elevation, 1,300 feet. Authority, Leon Lake.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1879-80	0.91	1.36	8.38	9.59	7.07	2.48	4.64	22.21	1.76	0	0	0	58.40
1880-81	0	0.06	0.02	21.86	17.85	5.95	1.83	2.52	0.29	0.34	0	0	50.72
1881-82	.55	1.26	1.05	8.09	2.86	6.80	4.60	2.57	.65	0	0	0	28.43
1882-83	.90	2.93	5.07	1.47	2.25	1.92	7.25	3.69	3.97	0	0	0	29.45
1883-84	2.55	1.36	.57	2.34	8.25	5.25	12.82	8.36	.06	3.28	0	0	44.84
1884-85	.50	2.08	.05	22.93	2.54	1.37	12.82	8.42	.30	2.98	0	0	53.99
1885-86	.15	.54	19.42	6.60	13.61	0.32	0.70	1.32	0	.27	0	0	42.93
1886-87				3.96	2.25	10.74	1.71	8.03	1.64	0			[a] 28.33
1892-93	.91	2.05	15.64	14.77	6.25	7.82	9.32	3.88	1.49	0	0	0	62.13
1893-94	.78	.36	3.06	3.36	14.37	8.32	2.09	2.05	2.06	.89	0	0	37.94
1894-95	1.28	3.18	1.92	20.52	28.90	3.40	5.87	1.77	1.75	0	0.10	0	68.69
1895-96	1.86	0	3.06	5.59	25.78	.06	5.79	8.54	2.23	0	.01	0.10	53.02
1896-97	.48	1.10	7.55	11.21									[a] 20.34
11-year mean													48.23

[a] Year incomplete.

Record of precipitation at Susanville, Lassen County.

[Latitude, 40° 23′; longitude, 120° 35′; elevation, 4,195 feet. Authority, T. B. Sanders.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1885-86	0.71	0.50	5.92	3.23	4.27	0.92	2.70	1.70	1.28	1.22	0.57	0.30	23.32
1886-87		1.32		2.23		5.57							[a] 9.12
1887-88													
1888-89	.71	.01	1.45	1.89	.03	.60	4.81	1.07	6.26	1.55	.05	0	18.43
1889-90	0	4.18	2.74	8.55	8.72	4.71	4.60	1.03	1.51	.14	0	.15	36.36
1890-91	.15	T.	.35	3.47	1.00	7.84	2.49	.80	2.41	1.65	.55	T.	20.71
1891-92	.65	.45	1.10	4.91	1.77	2.96	2.80	2.80	1.35	.98	0	0	19.77
1892-93	.71	.83	10.66	6.80	4.82	3.53	1.55	1.83	.67	0	T.	T.	31.40
1893-94	1.65	.60	1.80	.95	6.10	3.53	2.35	.95	1.55	.75	0	.20	20.43
1894-95	.30	1.96	.40	8.66	10.29	3.00	1.26	.50	1.50	T.	T.	.20	28.07
1895-96	3.00	.10	1.95	2.91	6.94	.05	3.23	5.10	2.22	T.	.20	.20	25.90
1896-97	1.33	.50	3.88	2.96	5.99	4.25	2.60	.30	.90	.42	0	.08	23.21
1897-98	.55	2.65	3.13	2.22	.45	2.38	.35	.24	.54	1.02	0	.08	13.61
1898-99	.10	.80	1.74	.65	2.90	.31	3.32	.92	1.42	0	0	.46	12.62
1899-1900	0	5.21	2.70	3.59	1.50	1.22	2.97	.90	.64	.40	.63	.02	19.78
1900-1901	.25	2.67	3.29	2.00	4.76	3.17	1.50	1.57	.92	.27	0	1.77	22.17
1901-2	.59	2.28	1.72	1.89	.70	5.14	2.56	1.31	.35	0	.54	.09	17.17
15-year mean													22.20

[a] Year incomplete.

Record of precipitation at Azusa, Los Angeles County.

[Latitude, 34° 8′; longitude, 117° 54′; elevation, 630 feet. Authority, H. F. Parkinson.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1897-98	0	4.25	0.25	T.	1.75	1.25	0.81	0.25	2.63	T.	T.	0	11.19
1898-99	.06	T.	T.	0.50	2.81	T.	2.49	T.	T.	1.25	0	T.	7.11
1899-1900	T.	2.55	1.79	1.00	1.31	T.	1.71	1.05	2.79	0	0	0	12.20
1900-1901	.13	.34	10.25	0	3.77	4.86	.50	.73	1.91	T.	T.	T.	22.49
1901-2	T.	2.35	.67	T.	2.24	2.84	3.99	.38	.18	.08	T.	0	12.73
5-year mean													13.14

Record of precipitation at Calabasas, Los Angeles County.

[Latitude, 34° 09′; longitude, 118° 38′; elevation, 925 feet. Authority, J. G. Chapman.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1901-2				0	1.28	4.35	2.17	0	0	0	0	0	7.80

Record of precipitation at Colby's Camp, Los Angeles County.

[Latitude, 118° 05′; longitude, 34° 15′; elevation, 3,875 feet. Authority, D. W. Colby, Pasadena.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1898-99					2.90	0.25	2.75	0.17	0.60	0.79	0	0	[a]7.46
1899-1900	0	3.66	1.25	1.26	1.15	0	2.00	1.38	3.25	0	0	0	13.95
1900-1901	0.25	.45	8.15	0	6.94	13.54	.67	2.65	1.10	.10	0	0.25	34.10
1901-2	.10	3.15	0	0	2.50	3.15	3.55	1.84	.20	.10	0	0	14.59
3-year mean													20.88

[a] Year incomplete.

Record of precipitation at Follows Camp (Azusa), Los Angeles County.

[Latitude, 34° 14′; longitude, 117° 49′; elevation, 1,800 feet. Authority, R. M. Follows, Azusa.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895-96				1.02	2.77	T.	6.55	0.70	0.36	0	0.07	1.10	[a]12.57
1896-97	T.	2.95	1.03	1.61	5.43	10.39	8.25	.15	.28	T.	0	.07	30.16
1897-98	.45	7.85	.20	.27	0	9.80	0	.85	6.16	1.03	0	.53	27.14
1898-99	0	0	1.70	.70	3.59	.84	2.49	.12	0	.91	0	0	10.35
1899-1900	.12	3.03	1.64	.44		T.	2.40	1.77	2.98				[a]12.38
1901-2			.80	.15									[a].95
3-year mean													22.55

[a] Year incomplete.

Record of precipitation at La Liebre, Los Angeles County.

[Latitude, 34° 46′; longitude, 118° 40′; elevation, 3,170 feet. Authority, J. W. Forbes, Neenack.]

Year.	Sept.	Oct.	Nov	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
896-97	.....	.....	.....	.....	3.67	4.01	2.30	0.10	.....	.....	.....	.....	[a] 10.08
897-98	.....	0.50	.....	0.40	.53	.38	.81	0	0.45	0	0	0	[a] 3.07
898-99	0.20	0	0	.66	1.79	.04	2.26	.09	.04	0.27	0	0	5.35
899-1900	.05	1.47	0.90	.46	1.24	.....	.....	.....	.....	.....	.....	.....	[a] 4.12

[a] Year incomplete.

Record of precipitation at Los Angeles, Los Angeles County.

Latitude, 34° 03′; longitude, 118° 15′; elevation, 330 feet. Authority, Signal Service and Weather Bureau.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Apr.	May.	June.	July.	Aug.	Total.
871-72	.....	.....	.....	.....	.....	2.25	0.43	0.97	0.10	0	0	0.22	[a] 3.97
872-73	0	0	0	4.42	2.08	7.19	.05	0	0	0	0	1.06	14.80
873-74	0	0	0.74	5.74	5.51	9.77	1.09	.45	.42	0	0	0	23.72
874-75	0.06	1.81	1.89	.20	17.22	.15	.22	.07	.05	0	0	0	21.67
875-76	0	0	7.57	.82	6.54	7.92	3.41	.45	.03	0	0	0	26.74
876-77	0	40	0	0	3.48	.01	.83	.26	.30	0	0	0	5.28
877-78	0	86	.45	3.93	3.33	7.68	2.57	1.71	.66	0.07	0	0	21.26
878-79	0	.14	0	4.70	3.59	.97	.49	1.19	.24	.03	0	0	11.35
879-80	0	93	3.44	6.53	1.33	1.56	1.45	5.06	.04	0	T.	T.	20.34
880-81	0	.14	.67	8 40	1.43	.36	1.66	.46	.01	0	0	T.	13.13
881-82	T.	.82	.27	.52	1.01	2 66	2.66	1.83	.63	T.	0	0	10.40
882-83	T.	.05	1.82	.08	1.62	3.47	2 87	.15	2.02	.03	T.	0	12.11
883-84	0	1.42	0	2.56	3.15	13.37	12.36	3.58	.39	1.39	0.02	.02	38.26
884-85	T.	.39	1.07	4.65	1.05	.01	.01	2.01	.06	T.	T.	T.	9.25
885-86	.05	30	5.55	1.65	7.78	1.41	2.52	2.32	,01	.11	.27	.21	22.18
886-87	.11	.02	1.18	26	.20	9.25	.29	2.36	.20	.07	.07	T.	14.01
887-88	.18	.17	.80	2.68	6.04	.80	3.17	.12	.05	.01	.04	.10	14.16
888-89	.03	.40	4.02	6.26	.25	.92	6.48	.27	.65	01	T.	.28	19.57
889-90	.34	6.96	1.35	15.80	7.83	1.36	.66	.22	.03	.02	0	.03	34.60
890-91	.06	.03	.13	2.32	.25	8.56	.41	1.26	.31	0	T.	0	13.33
891-92	.06	0	0	1.99	.88	3.19	3.39	.22	2.06	.06	0	.01	11.86
892-93	0	.33	4.40	4.18	6.29	2.27	8.52	19	.06	03	0	0	26.27
893-94	T	.75	.20	3.65	.94	.49	.37	.13	.20	T.	T.	.01	6.74
894-95	.73	.02	0	4.62	5.84	.46	3.77	.46	.19	01	T.	T.	16.10
895-96	T	.24	.80	.78	3.23	T.	2.97	.19	.30	T.	.02	.01	8.54
896-97	T	1.30	1.66	2.12	3.70	5.62	2.31	.02	.10	T.	T.	0	16.83
897-98	0	2.47	.01	05	1.26	.51	.98	.03	1.75	T.	.07	T.	7.13
898-99	02	.09	T.	.12	2.64	.04	1.81	.18	.04	.58	0	.01	5.53
899-1900	T	1.59	.90	.90	1.17	T.	.99	.54	1.81	T.	T.	T.	7.90
900-1901	T	.26	6.53	T.	2.49	4.38	.45	.68	1.50	T.	T.	.09	16.38
901-2	.03	1.88	46	0	1.62	3.35	2.98	.16	.03	T.	0	0	10.51
1 year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.00

[a] Year incomplete.

Record of precipitation at Magic Hill, No. 1, Los Angeles County.

[Latitude, 34° 23′; longitude, 118° 22′; elevation, 2,820 feet. Authority, B. L. Hutchins, Burbank.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1897-98	.....	.....	0.10	0.30	0.25	0.61	0	0.34	0.29	1.80	1.35	0.52	[a]5.56
1898-99	3.12	.....	.....	.....	1.60	15	2.07	.14	1.65	.05	0	0	[a]8.78
1899-1900	07	2.25	1.07	1.20	1.34	0	1.67	2.05	4.40	.06	.04	0	14.15
1900-1901	54	.71	6.53	0	6.71	6.68	.78	1.79	.57	.....	.....	.....	[b]24.31

[a] Year incomplete. [b] Record stopped.

Record of precipitation at Manzana, Los Angeles County.

[Latitude, 34° 45′; longitude, 118° 35′; elevation, 2,850 feet. Authority, E. A. Silrey.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893-94	.....	.....	.....	.....	0.21	0.37	0.36	T.	0.35	0.17	0	0.10	[a]1.56
1894-95	0.49	0	0	3.60	2.79	0	1.36	0.08	T.	0	0	0	8.32
1895-96	0	0.40	0.48	.18	1.09	0	1.70	.63	T.	0	0	.10	4.58
1896-97	0	.61	.30	1.46	2.70	3.04	1.71	.04	.01	T.	T.	.28	10.13
1897-98	0	.21	T.	.14	.63	.02	.47	0	.24	0	0	0	1.7[illegible]
1898-99	T.	0	0	.50	1.15	T.	1.35	.04	.09	.04	0	0	3.1[illegible]
1899-1900	0	1.27	.71	.29	1.11	.10	.93	.42	.38	0	0	.08	5.2[illegible]
1900-1901	.10	.09	2.55	0	3.20	6.68	.25	.61	.12	0	0	.65	14.2[illegible]
1901-2	T	2.02	.20	T.	.67	1.52	1.14	0	.15	T.	0	0	5.70
8-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.6[illegible]

[a] Year incomplete.

Record of precipitation at Mount Lowe (Echo Mountain post-office), Los Angeles County.

[Latitude, 34° 15′; longitude, 118° 07′; elevation, 3,200 feet. Authority, Louis Swift and Edgar L. Larkin.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895-96	.....	.....	.....	1.35	2.85	0.10	4.10	0.60	0.30	0	0	0	[a]9.[illegible]
1896-97	0	2.39	1.55	2.17	6.42	7.47	6.67	.19	.87	0.10	0.15	0	27.[illegible]
1897-98	0	2.57	.40	.22	1.55	2.22	1.65	2.70	2.17	0	0	0	13.4[illegible]
1898-99	0.25	.30	0	.98	3.29	0	3.40	.20	1.90	.40	0	0	10.7[illegible]
1899-1900	0	3.00	2.85	.....	.....	.....	2.90	2.15	4.05	.40	T.	0	[a]15.[illegible]
1900-1901	.25	1.66	11.71	0	7.55	5.42	1.18	1.14	4.45	.75	0	0	34.[illegible]
1901-2	0	4.18	1.05	.23	1.88	3.48	5.97	1.35	.33	.50	0	0	18.[illegible]
5-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21.[illegible]

[a] Year incomplete.

Record of precipitation at Mount Sister Elsie, Los Angeles County.

[Latitude, 34° 17′; longitude, 118° 14′; elevation, 5,021 feet. Authority, L. T. Rowley, Monte Vista.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1898-99	.....	.....	.....	.....	2.95	0.12	3.37	0.58	0.08	0.78	0	0	[a]7.[illegible]
1899-1900	0.35	2.10	1.34	0.41	.85	0	1.87	1.30	3.02	0	0	T.	11.[illegible]
1900-1901	.09	.81	6.70	0	8.92	12.13	.95	3.60	1.93	.....	.....	.....	[c]35.[illegible]

[a] Year incomplete. [c] Record discontinued.

Record of precipitation at Newhall, Los Angeles County.

[Latitude, 34° 25′; longitude, 118° 33′; elevation, 1,268 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1876-77	0	0	0	0	1.56	T.	0.43	0.50	0.56	0	0	0	3.05
1877-78	0	0.03	0.32	1.45	3.78	3.23	1.02	1.46	.15	0	0	0	11.44
1878-79	0	0	0	2.33	2.25	.62	0	1.52	.05	0	0	0	6.77
1879-80	0	.37	3.10	9.23	.10	2.25	1.08	3.39	0	0	0	0	19.52
1880-81	0	0	.26	6.22	.57	.06	1.70	.34	0	0	0	0	9.15
1881-82	0	1.23	.12	4.21	.43	2.36	4.71	.93	0	0	0	0	13.99
1882-83	0	.16	1.20	0	1.96	2.95	3.07	0	2.28	0	0	0	11.62
1883-84	0	.16	0	3.34	6.66	14.53	9.73	3.85	2.17	1.67	0	0	42.11
1884-85	0	.60	1.10	3.89	.47	0	.07	1.75	0	.06	0.02	0	7.96
1885-86	0	0	9.01	2.25	5.22	.69	3.11	4.27	0	T.	0	0	24.55
1886-87	0	0	.87	.21	0	12.38	.15	1.96	.10	.03	0	0	15.70
1887-88	0.02	.65	1.46	4.26	6.74	1.17	4.21	.29	.04	0	0	0	18.84
1888-89	0	.40	3.69	5.64	.35	(.08)	9.39	.40	.56	0	0	0.36	21.59
1889-90	0	(2.50)	3.36	15.70	6.30	4.41	.44	.33	(0.00)	0	0	0	33.04
1890-91	.35	0	0	1.94	.31	9.99	.88	1.26	.66	0	T.	0	15.39
1891-92	.13	0	0	2.12	1.32	3.02	4.07	.06	2.08	0	0	0	12.80
1892-93	0	.30	4.72	4.16	3.91	1.34	7.90	.47	.34	0	0	0	23.14
1893-94	0	.72	0	3.90	.85	.29	.62	.15	.66	0	0	0	7.19
1894-95	.80	0	0	7.59	7.11	.31	3.66	.39	0	0	0	0	19.86
1895-96	0	.10	1.09	.11	2.15	.15	4.04	1.03	.20	0	0	.25	9.12
1896-97	0	1.55	1.00	2.23	4.86	5.08	3.32	0	.08	0	0	0	18.12
1897-98	0	1.00	0	0	.45	3.14	0	.10	.93	0	0	0	5.62
1898-99	.14	0	0	.22	2.77	0	1.98	.08	0	.25	0	0	5.44
1899-1900	0	1.63	.90	.64	.89	0	1.97	.25	1.31	0	0	0	7.59
1900-1901	0	.08	5.24	0	5.13	6.14	.13	.74	1.62	0	0	0	19.08
1901-2	.10	2.32	.70	0	1.00	2.90	2.53	.34	0	0	0	0	9.89
26-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.10

NOTE.—February and October, 1889, and May, 1890, estimated by War Department.

Record of precipitation at Palmdale (Headworks), Los Angeles County.

[Latitude, 34° 25′; longitude, 118° 03′; elevation, 3,299 feet. Authority, Burt. Cole and S. T. Berkley.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895-96	T.	T.	0.75	0.10	1.00	T.	2.50	T.	0	0	0.25	1.35	5.95
1896-97	0.32	1.42	.43	.98	3.78	3.71	1.31	0.04	0.32	0	.03	1.57	13.91
1897-98	T.	.86	0	.14	2.38	.07	.90	0	.21	0	.02	.05	4.63
1898-99	0	0	T.	.87	1.00	.31	.97	0	0	0	0	0	3.15
1899-1900	0	1.28	.27	.32	.65	0	.80	.57	.76	0	0	0	4.65
1900-1901	0	.20	1.79	0	1.34	4.50	.38	.15	T.	0	0	.33	8.69
1901-2	T.	.32	.04	0	1.17	1.08	1.96	.20	0	T.	0	0	4.77
7-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.86

Record of precipitation at San Fernando, Los Angeles County.

[Latitude, 34° 16′; longitude, 118° 26′; elevation, 1,066 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1877-78	0	0.01	0.48	2.36	4.15	6.89	2.08	2.55	0.36	0	0	0	18.91
1878-79	0	.16	.09	1.20	3.97	.86	.18	1.41	0	0	0	0	7.87
1879-80	0	.33	2.15	6.29	.95	2.00	1.14	2.97	0	0	0	0	15.83
1880-81	0	0	.86	4.72	1.28	.34	1.75	.50	0	0	0	0	9.45
1881-82	0	.95	.16	.32	.62	1.70	3.21	1.56	.10	0	0	0	8.62
1882-83	0	.28	.68	0	1.32	3.17	1.30	.13	2.12	0	0	0	9.00
1883-84	0	.70	0	2.76	3.00	10.60	10.51	3.48	1.05	2.00	0	0	34.10
1884-85	0	.42	1.00	4.96	.90	0	T.	1.48	.21	0	0	0	8.97
1885-86	0	0	7.94	1.17	6.70	T.	3.36	3.39	0	0	0.19	T.	22.75
1886-87	0	.78	.87	.24	.21	8.54	.27	2.52	T.	0	0	0	13.43
1887-88	.04	.22	.90	1.41	5.09	1.39	3.40	.44	0	0	0	0	12.89
1888-89	0	.36	3.24	5.40	.09	.63	8.95	.56	.43	0	0	0.06	19.72
1889-90	.32	6.17	1.60	14.40	5.40	2.72	.53	.05	.10	0	0	0	31.29
1890-91	.36	0	.18	1.61	.30	6.32	1.23	.96	.98	0	0	0	11.94
1891-92	.12	0	0	1.03	.57	2.53	2.65	.21	1.68	0	0	0	8.79
1892-93	0	.40	1.48	4.40	2.63	3.67	6.93	.56	.08	0	0	0	20.15
1893-94	0	.61	.05	2.23	.59	.61	.75	.24	.32	0	0	0	5.45
1894-95	0	.02	0	5.82	7.62	1.11	3.72	.55	.28	0	0	0	19.12
1895-96	0	.21	.90	.61	2.42	.05	3.32	.29	.15	0	0	.33	8.28
1896-97	0	1.48	.96	2.12	5.39	5.58	2.88	0	0	0	0	0	18.41
1897-98	0	1.66	0	0	1.42	.57	.86	.10	1.42	0	.17	0	6.20
1898-99	.10	.25	0	.20	1.29	0	1.45	0	T.	.68	0	0	3.97
1899-1900	0	1.65	.82	1.04	1.31	0	1.45	.25	1.87	0	0	0	8.39
1900-1901	T.	.11	6.19	0	4.17	5.20	.15	.72	.62	0	0	0	17.19
1901-2	T.	1.40	.50	0	1.05	2.72	2.80	.29	0	0	0	0	8.76
25-year mean													13.98

Record of precipitation at San Gabriel Electric Company's power house, Azusa, Los Angeles, County.

[Latitude, 34° 09′; longitude, 117° 54′; elevation, 1,000 feet. Authority, San Gabriel Electric Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900-1901	0.19	0	9.76	0	5.23	3.81	0.58	1.35	1.87	0	0	0.03	12.87
1901-2	0	3.15	.64	0	1.98	3.03	4.69	.36	.23	0.14	0	0	14.22
2-year mean													13.55

Record of precipitation at San Gabriel Electric Company's headgate, Los Angeles County.

[Latitude, 34° 13′; longitude, 117° 52′; elevation, 1,100 feet. Authority, San Gabriel Electric Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900-1901	0.10	0	11.25	0	6.44	5.09	0.48	1.15	2.90	0	0	0.02	27.43
1901-2	0	1.58	1.08	.18	1.83	3.61	6.24	1.35	.10	.19	0	0	19.16
2-year mean													23.30

Record of precipitation at San Gabriel Electric Company's Sierra power house, Los Angeles County.

[Latitude, 34° 13′; longitude, 117° 40′; elevation, 2,750 feet. Authority, San Gabriel Electric Company.]

Year.	Sept.	Oct.	Nov.	Dec	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900–1901	------	------	------	------	10.35	8.15	0.78	0.36	2.78	0.01	0	0	[a] 22.43
1901–2	0	3.99	0.97	0.24	2.13	3.45	7.53	1.13	.20	.11	.03	0	19.78

[a] Year incomplete.

Record of precipitation at Coulterville, Mariposa County.

[Latitude, 37° 43′; longitude, 120° 12′; elevation, 1,660 feet. Authority, N. C. Ray.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1898–99	0	0	0.76	2.04	4.69	0.46	8.85	0.53	0.34	0.97	0	0	18.64
1899–1900	0	4.37	5.70	3.32	2.01	.60	1.47	2.90	1.14	.33	0	0	21.84
1900–1901	0.18	3.82	8.27	1.39	4.99	8.04	1.28	.66	3.29	T.	T.	T.	31.92
1901–2	1.35	1.92	2.09	1.39	0	0	0	0	0	.09	0	T.	6.82
4-year mean	------	------	------	------	------	------	------	------	------	------	------	------	19.81

Record of precipitation at Yosemite, Mariposa County.

[Latitude, 37° 45′; longitude, 119° 35′; elevation, 4,063 feet. Authority, Galen Clark.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Total.
1896–97	0.85	1.36	6.19	9.33	6.62	11.53	16.32	0.40	0.62	0.16	------	------	[a] 53.38

[a] Year incomplete.

Record of precipitation at Camp Wright, Mendocino County.

[Latitude, 39° 45′; longitude, 123° 00′; elevation, 1,800 feet. Authority, U. S. War Department.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1864–65	0.03	0.85	6.19	12.20	3.64	4.88	3.57	0.36	0.43	0	0	0	32.15
1865–66	.81	.87	16.67	2.05	15.83	4.30	11.80	1.05	------	------	------	------	[a] 53.38
1866–67	0	0	5.92	24.67	8.92	7.85	2.38	3.10	.01	0	0	0	52.85
1867–68	1.56	3.75	6.38	29.03	8.61	5.89	9.11	3.25	.71	1.58	0	0	69.87
1868–69	.05	.25	2.79	6.63	13.57	4.13	3.80	4.51	.55	0	0	0	36.28
1869–70	1.42	.84	5.38	8.06	7.03	6.61	2.40	2.02	39	0	0	0	34.15
1870–71	0	0	1.28	1.19	2.66	4.60	7.10	1.07	1.96	0	0	0	19.86
1871–72	.50	.31	4.03	16.64	11.52	19.78	5.34	.66	.12	.04	0	0.20	59.14
1872–73	0	.36	5.20	7.24	3.55	6.92	2.91	1.13	.04	.30	0.10	0	27.75
1873–74	.05	.34	4.98	15.50	12.94	5.46	7.26	3.72	1.16	.26	.01	0	51.68
1874–75	0	5.61	12.99	2.27	9.83	1.06	1.76	.59	2.32	0	0	0	36.43
10-year mean	------	------	------	------	------	------	------	------	------	------	------	------	42.02

[a] Year incomplete.

Record of precipitation at Alturas, Modoc County.

[Latitude, 41° 30′; longitude, 120° 30′; elevation, 4,300 feet. Authority, J. H. Stewart.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1891-92		0.83	0.74	1.21	0.01	.....	.....	.....	.....	.....	.....	.....	2.79

Record of precipitation at Fort Bidwell, Modoc County.

[Latitude, 41° 53′; longitude, 120° 11′; elevation, 4,640 feet. Authority, U. S. War Department.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1866-67	0	1.00	3.50	5.80	12.00	4.80	6.70	1.30	0	0.60	0.10	1.40	37.20
1867-68	2.80	.80	3.10	8.20	3.50	.40	4.00	.60	2.40	4.10	.35	0	30.25
1868-69	.20	.10	.80	.90	2.50	.40	2.36	1.55	.70	.20	.70	0	10.41
1869-70	.45	0	2.37	2.30	12.71	5.40	3.21	1.41	2.87	1.36	.76	.05	32.89
1870-71	0	.03	2.29	9.10	1.23	3.26	3.21	0	.97	.16	.38	.02	20.65
1871-72	.20	.20	.79	3.25	1.16	3.97	1.32	.77	1.82	.06	0	.26	13.80
1872-73	1.18	.46	1.69	1.94	2.22	1.66	.60	2.06	.78	.10	.14	.21	13.04
1873-74	.40	.63	1.14	3.29	1.51	1.08	1.05	1.12	.64	1.06	.05	.27	12.24
1874-75	0	.99	2.74	.13	2.10	.07	2.15	.45	1.30	1.00	0	.05	10.98
1875-76	0	1.80	2.62	1.54	3.57	.32	.80	.53	.98	.43	0	0	12.59
1876-77	0	1.99	4.32	2.05	9.36	3.30	4.10	2.14	4.66	2.10	.10	.35	34.47
1877-78	.10	.80	3.03	.35	.75	4.65	2.35	1.05	.82	.20	.25	.37	14.72
1878-79	.70	.30	.25	.20	3.90	2.63	.95	1.00	1.40	.15	.15	.30	11.93
1879-80	.10	1.34	1.75	6.60	3.10	3.80	3.36	5.60	1.38	.26	.72	.42	28.43
1880-81	.05	.50	.56	6.09	10.00	6.00	1.50	3.02	.84	1.59	.32	.10	30.57
1881-82	.24	3.55	2.87	3.40	3.44	2.82	1.46	1.72	.64	.38	.16	0	20.68
1882-83	.48	2.73	.92	1.77	2.52	.64	.77	1.56	1.30	0	0	0	12.69
1883-84	0	1.18	1.14	1.06	1.14	2.96	.72	.68	.40	4.29	.67	.08	14.32
1884-85	1.40	.73	T.	6.81	2.09	1.82	.04	3.45	1.99	1.05	1.38	.17	20.93
1885-86	.09	.75	8.46	3.74	5.78	2.16	1.48	2.20	1.44	.78	.41	.04	27.33
1886-87	0	1.36	1.06	4.25	3.31	4.85	.97	1.96	1.47	.73	.18	.21	20.35
1887-88	.05	0	.38	2.40	3.28	1.81	3.28	.16	1.50	2.38	.34	.04	15.62
1888-89	.33	.20	2.03	3.28	2.81	.20	7.31	1.08	1.62	.78	0	0	19.64
1889-90	0	3.61	2.20	3.78	7.45	3.97	3.97	.92	1.07	.33	.05	.05	27.40
1890-91	1.60	.10	0	1.00	.50	3.98	3.83	1.39	1.57	2.73	1.55	.19	18.44
1891-92	.13	.19	1.57	2.76	.79	1.20	.69	2.28	1.57	1.46	.15	.02	12.81
1892-93	.91	1.28	3.12	2.64	2.60	2.92	1.60	1.88	1.66	.01	.50	.05	19.17
25-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20.13

Record of precipitation at Jolon, Monterey County.

[Latitude, 36° 00′; longitude, 121° 15′; elevation, 960 feet. Authority, F. T. Tidball.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1882–83	0.50	0.25	2.05	2.75	1.25	0.85	5.05	0.75	2.45	0	0	0	15.90
1883–84	0	.60	0	1.00	5.75	7.56	9.02	3.35	.50	0.60	0	0.25	28.63
1884–85	0	2.60	.60	4.09	2.31	T.	T.	2.15	0	0	0	0	11.75
1885–86	0	.10	13.15	2.42	8.51	.86	2.37	4.01	0	0	0	0	31.42
1886–87	0	.35	.48	.61	.57	8.52	.38	1.11	.40	T.	0	0	12.42
1887–88	.21	.21	.94	4.42	5.64	.16	4.81	0	.37	.01	T.	0	16.77
1888–89	.60	0	5.64	4.48	1.25	1.40	9.65	.59	1.12	0	0	0	24.74
1889–90	0	7.38	4.09	11.42	6.58	4.59	2.50	65	.30	0	0	.03	36.94
1890–91	.90	0	.57	2.25	.55	8.75	.99	.94	.02	T.	(.00)	(.00)	14.97
1891–92	T.	(.14)	.03	2.99	.84	1.78	2.31	.32	2.25	T.	0	0	10.66
1892–93	0	.23	6.40	6.61	3.83	3.29	5.30	1.35	.22	0	0	0	27.23
1893–94	0	T.	.15	2.31	.1.48	.68	.46	.22	1.35	.52	0.05	.05	7.27
1894–95	1.20	.75	.30	8.30	6.16	.32	1.68	.85	.02	0	0	0	19.58
1895–96	.03	1.80	.96	.50	8.14	.03	2.61	3.62	.09	0	.10	.08	17.96
1896–97	.03	.75	3.20	2.11	4.61	2.50	3.54	0	0	.08	0	.03	16.85
1897–98	.15	.43	.12	.46	.85	2.10	.60	.07	.52	T.	0	0	5.30
1898–99	.30	.16	.24	.40	4.55	.13	4.31	1.74	.17	T.	0	0	12.00
1899–1900	0	2.10	1.50	2.30	3.03	.11	1.00	.68	1.18	0	T.	0	11.90
1900–1901	0	2.00	7.53	.53	4.84	6.21	2.58	2.10	.33	0	T.	0	26.12
1901–2	.05	1.16	1.69	0	.99	6.49	3.03	1.28	.08	0	0	0	14.77
20-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18.16

Record of precipitation at Matthews Ranch, near King City, Monterey County.

[Latitude, 36° 15′; longitude, 121° 00′; elevation, 333 feet. Authority, J. L. Matthews.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1901–2	.....	.....	1.37	0.10	0.71	3.74	2.38	0.81	.....	.....	.....	.....	9.11

Record of precipitation at Priests Valley, Monterey County.

[Latitude, 36° 12′; longitude, 120° 45′; elevation, 2,250 feet. Authority, A. J. Myers and Mrs. Martin Griffin, Soledad.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total
1898–99	0.13	0.17	0.36	0.34	4.01	0	5.30	1.33	0.52	0	0	0	12.16
1899–1900	0	3.61	1.82	2.81	2.53	0.16	2.37	1.17	1.23	0	0	0	15.70
1900–1901	0	2.50	7.98	.64	6.27	9.51	.80	2.44	1.59	0	0	0	31.13
1901–2	0	2.57	2.08	.66	.70	5.42	3.60	1.84	.24	0	0	0	17.11
4-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.18

Record of precipitation at Salinas City, Monterey County.

[Latitude, 36° 41′; longitude, 121° 36′; elevation, 45 feet. Authority, Dr. E. K. Abbott.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1871-72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	0	[a]0
1872-73	0.01	0	0	6.80	3.40	2.40	0.80	0	0	0	0	0	13.41
1873-74	.10	0.10	0.20	4.25	3.42	0	2.15	0.95	0	0	0	0	11.17
1874-75	0	1.83	1.42	0	4.50	.15	.69	0	0	0	0	0	8.59
1875-76	0	0	5.17	1.98	6.16	3.55	4.52	0	0.01	0	0.10	0	21.49
1876-77	.05	1.04	.05	0	2.54	.16	.30	.10	.40	0	0	0	4.64
1877-78	0	.12	1.00	2.39	7.05	8.77	2.57	1.93	0	0	0	0	23.83
1878-79	.05	.60	.20	.35	2.42	2.81	1.85	1.69	.82	0.15	0	0	10.94
1879-80	0	1.05	1.08	2.28	1.65	1.16	1.64	3.90	.46	0	0	0	13.22
1880-81	0	0	.57	5.55	3.32	2.32	1.26	.66	0	.38	0	0	14.07
1881-82	.10	.28	.67	1.24	1.78	2.31	4.86	1.01	.49	.19	0	0	12.93
1882-83	.38	1.43	.65	1.95	.91	.95	2.26	1.28	1.98	0	0	0	11.79
1883-84	.19	1.19	.25	.90	1.71	4.49	5.09	3.05	.72	2.66	0	0.18	20.43
1884-85	.11	1.79	.28	4.45	1.09	.05	.19	1.21	.12	0	0	0	9.30
1885-86	.02	.08	6.60	1.30	5.10	1.47	2.16	3.83	0	0	0	0	20.56
1886-87	0	.62	.82	.72	.75	4.73	.54	1.63	.07	0	0	0	9.88
1887-88	.71	0	.98	2.16	4.15	.53	3.28	0	.89	0	0	0	12.70
1888-89	.56	0	1.64	2.20	.64	1.65	3.31	.95	.68	0	0	0	11.63
1889-90	0	4.20	2.41	8.90	5.99	3.05	1.79	.60	.65	0	0	0	27.59
1890-91	0	.29	.44	2.05	.59	4.40	.43	2.53	.33	0	0	0	11.06
1891-92	.12	.17	.30	4.66	.44	1.57	2.78	.85	.65	0	0	0	11.54
1892-93	.08	.66	4.09	2.13	1.07	2.91	5.14	.91	0	0	0	0	16.99
1893-94	0	.33	.66	1.50	5.17	3.36	.82	.53	1.57	.26	0	0	14.20
1894-95	1.16	.87	.41	5.35	5.10	1.41	2.07	.94	.45	0	0	0	17.76
1895-96	0	.56	.79	.83	5.65	.22	1.68	2.64	.45	0	0	.42	13.24
1896-97	.02	1.01	3.08	2.02	.66	3.34	4.51	.11	.06	.12	0	0	14.93
1897-98	.56	.78	.97	.96	.96	1.66	1.06	.23	1.22	.10	0	0	8.50
1898-99	.17	.38	.34	1.18	2.98	.50	4.11	.75	.14	0	0	0	10.55
1899-1900	0	2.65	2.96	1.80	.84	.77	1.00	1.41	.25	0	0	0	11.68
1900-1901	0	.69	5.65	.71	1.69	5.44	.50	1.48	.35	0	0	0	16.51
1901-2	.38	.50	1.27	.20	1.01	3.50	2.58	.87	.27	0	0	0	10.58
30-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.86

[a] Year incomplete.

Record of precipitation at San Ardo, Monterey County.

[Latitude, 36° 09′; longitude, 121° 10′; elevation, 452 feet. Authority, Pacific Railway System.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1886-87	0	0	0.35	0.17	0.58	5.58	0.17	0.76	0.05	0.26	0	0	7.92
1887-88	0.14	0.37	.32	2.07	3.44	.28	2.91	.11	.27	0	0	0	9.91
1888-89	0	0	3.24	2.31	.83	.80	6.16	.49	.27	0	0	0	14.10
1889-90	0	4.74	2.96	7.16	3.36	3.59	.99	0	.43	0	0	0.04	23.27
1890-91	1.10	0	.11	1.41	.43	3.99	.76	1.04	.03	0	0	0	8.87
1891-92	.11	0	0	1.57	.58	.48	1.37	.08	1.61	0	0	0	5.82
1892-93	0	.15	1.80	3.40	1.55	1.31	3.94	.62	.15	0	0	0	12.92
1893-94	0	0	.21	1.06	1.18	.34	.13	.10	.68	.15	0	0	3.85
1894-95	.65	.25	.02	4.42	3.98	.23	.94	.41	.02	0	0	0	10.92
1895-96	0	1.48	2.86	.30	5.10	0	2.11	2.27	.25	0	0	.22	14.58
1896-97	0	.45	2.73	1.54	.89	1.18	2.19	.06	0	0	0	.02	9.06
1897-98	0	.78	.05	.42	.38	.89	.70	0	.43	0	0	T.	3.65
1898-99	T.	.15	.20	.15	3.24	.03	2.81	.84	T.	T.	0	T.	7.40
1899-1900	0	1.65	.96	1.09	1.68	.15	1.15	.39	.66	T.	T.	0	7.75
1900-1901	T.	.88	4.30	.08	3.89	4.17	.51	.67	1.20	0	0	0	15.76
1901-2	.05	.94	1.49	0	.66	4.29	2.20	.74	T.	0	0	0	10.37
16-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.38

Record of precipitation at Boca, Nevada County.

[Latitude, 39° 24′; longitude, 120° 06′; elevation, 5,531 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1869-70	------	------	------	------	------	3.85	1.82	0.81	0.55	0.26	0.12	0	[a] 7.41
1870-71	0	0.80	0.04	1.10	2.50	2.32	1.60	.45	0	.10	2.00	0	10.91
1871-72	0	0	.60	7.30	3.00	.90	.10	1.50	.10	0	0	0	13.50
1872-73	0	0	.20	2.60	1.80	4.10	.10	.10	.75	0	0	0	9.65
1873-74	0	0	0	4.30	4.70	2.40	6.20	.80	.60	0	.60	0	19.60
1874-75	.10	2.15	3.70	.60	6.30	0	.65	.60	0	.40	T	0	14.50
1875-76	0	T.	1.56	1.65	8.10	3.60	4.72	.70	.10	0	.22	0.01	20.66
1876-77	.01	.25	.02	0	5.22	0	.46	.95	.36	.10	0	0	7.37
1877-78	0	0	1.50	.30	3.94	6.74	.86	1.30	0	.13	.08	0	14.85
1878-79	.17	.99	1.60	0	5.47	2.92	4.80	2.08	.45	0	0	0	18.48
1879-80	0	.20	.98	4.18	0	3.00	2.90	6.95	.75	0	0	0	18.96
1880-81	0	0	0	3.74	0	0	.12	0	0	0	0	0	3.86
1881-82	.14	.10	1.20	1.00	3.90	3.60	10.20	1.00	0	0	0	0	21.14
1882-83	0	.80	.90	.60	1.15	2.20	1.70	.90	1.80	0	0	0	10.05
1883-84	.14	2.45	.50	.60	4.60	6.30	5.10	1.90	.30	1.40	0	0	23.29
1884-85	T.	.80	0	8.20	1.00	.10	.10	1.50	0	.30	0	0	12.00
1885-86	0	0	2.40	2.98	8.35	.85	4.40	1.30	.50	0	.15	0	20.93
1886-87	.10	.70	.70	.70	2.40	12.70	0	1.80	T.	.26	.15	T.	19.51
1887-88	0	0	.30	3.74	4.18	1.00	2.40	.10	.51	.10	.15	.30	12.92
1888-89	.12	0	.95	1.45	4.18	3.63	1.15	.10	3.90	0	0	0	15.48
1889-90	.14	1.50	4.55	19.85	14.60	5.40	5.45	1.50	.70	.26	0	0	53.95
1890-91	0	.70	0	3.65	1.25	11.80	2.50	1.70	.84	.26	.15	0	22.85
1891-92	.60	0	.25	8.30	.70	3.35	1.70	2.70	3.10	.70	0	0	21.40
1892-93	0	1.50	8.35	6.95	4.55	8.90	4.00	1.90	1.35	0	0	.05	37.55
1893-94	.55	.25	2.42	3.70	5.10	7.55	.75	1.00	.33	T	0	T	21.65
1894-95	T.	.61	.50	11.80	8.36	1.20	.45	.70	.90	T	0	T	24.52
1895-96	.97	.11	.01	1.52	7.75	.50	6.30	6.65	3.10	.25	1.15	.18	28.49
1896-97	.35	0	2.47	1.80	2.20	6.35	8.35	.10	.50	.40	0	.50	23.02
1897-98	T	2.10	2.80	2.72	1.55	2.90	2.50	1.30	.85	1.00	0	0	17.72
1898-99	.01	1.28	1.84	1.58	6.80	1.85	7.95	.85	2.40	.10	0	.98	25.64
1899-1900	0	4.42	2.59	4.53	1.57	.60	3.52	4.27	1.10	2.67	T.	1.22	26.49
1900-1901	.66	3.04	5.73	4.58	7.17	6.76	2.24	2.04	1.86	0	0	.08	34.16
1901-2	.40	.80	1.15	3.77	1.30	2.50	2.70	T.	T.	0	.10	0	12.72
32-year mean	------	------	------	------	------	------	------	------	------	------	------	------	19.93

[a] Year incomplete.

Record of precipitation at Bowman's dam, Nevada County.

[Latitude 39° 27'; longitude 120° 39'; elevation, 5,400 feet. Authority, H. C. Perkins and W. H. Radford.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1871-72	0	0.98	7.88	38.20	12.98	27.08	7.52	4.57	1.09	1.04	0.88	0	102.22
1872-73	0.25	.73	5.43	17.41	5.73	16.17	3.82	3.20	2.65	0	.06	0	55.45
1873-74	0	1.24	4.37	23.47	21.53	9.98	17.73	5.47	3.93	.45	0	0.08	88.25
1874-75	0	4.54	15.35	1.58	16.91	.25	5.18	.83	2.85	2.38	.25	0	50.12
1875-76	0	3.09	23.43	10.77	17.62	11.70	18.01	5.92	.99	.36	1.28	0	93.17
1876-77	.41	10.76	.53	0	14.33	3.18	7.49	3.17	3.33	1.17	0	0	44.37
1877-78	0	1.52	8.26	1.71	17.00	21.21	10.07	2.57	2.06	.10	.09	.13	64.72
1878-79	0	2.83	5.36	1.30	14.50	14.28	20.97	9.57	3.93	.71	.05	.10	73.60
1879-80	0	3.41	9.62	15.00	9.27	8.17	9.51	31.72	8.90	0	0	0	95.60
1880-81	0	0	.65	25.05	27.82	15.08	7.29	4.44	1.22	0	0	0	81.55
1881-82	2.33	6.09	4.25	10.78	11.46	7.47	15.17	7.96	1.16	0	0	0	66.67
1882-83	2.94	11.47	6.51	4.32	5.06	5.28	12.79	5.15	0	0	0	0	53.52
1883-84	2.45	5.03	2.46	5.20	13.50	19.45	18.02	12.44	2.01	3.53	0	0	84.09
1884-85	1.08	3.04	0	46.57	4.49	3.74	.80	6.41	1.57	2.64	0	0	70.34
1885-86	1.26	0	24.96	8.66	17.84	2.99	7.24	13.22	3.20	0	0	0	79.37
1886-87	0	2.25	1.76	6.95	7.46	21.60	2.27	5.81	1.93	.76	0	0	50.79
1887-88	0	0	1.25	8.97	------	------	------	------	------	------	------	------	[a] 10.22
1894-95	------	------	------	------	------	8.77	9.65	------	9.15	0	T.	.37	[a] 27.94
1895-96	10.12	.45	2.81	11.20	29.85	1.92	14.95	18.45	8.98	.11	.09	1.00	99.93
1896-97	2.05	2.83	19.40	10.31	4.88	18.31	18.91	2.85	.92	4.04	0	T.	84.50
1897-98	.61	4.74	5.35	5.31	3.01	12.23	2.63	2.10	3.95	2.12	0	0	42.05
1898-99	.55	2.64	7.51	3.22	14.11	2.54	26.31	1.73	4.80	1.04	0	1.15	65.60
1899-1900	0	16.27	12.53	15.72	9.60	4.44	10.77	6.62	2.67	.40	.02	0	79.04
1900-1901	1.38	12.98	11.47	8.15	14.30	18.79	4.67	5.99	1.73	T.	T.	.05	79.51
1901-2	4.12	4.28	7.54	8.01	2.40	21.08	9.26	5.96	2.76	.46	.09	T.	65.96
23-year mean	------	------	------	------	------	------	------	------	------	------	------	------	72.63

[a] Year incomplete.

Record of precipitation at Grass Valley, Nevada County.

[Latitude, 39° 13′; longitude, 121° 4′; elevation, 2,090 feet. Authority, Mr. Loutzenhuser and B. F. Berriman.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1872–73	0	0	0	13.13	4.01	12.52	1.39	2.32	2.56	0	0	0	35.93
1873–74	0	0.83	2.99	19.01	13.71	6.93	11.71	3.76	1.05	0.10	0	0	60.09
1874–75	0	2.95	15.91	1.08	15.56	1.39	4.14	.29	1.18	2.28	0	0	44.78
1875–76	0	.97	16.99	7.44	12.01	10.75	12.47	2.80	1.23	0	.65	0	65.31
1876–77	0.06	8.72	.62	0	10.18	2.44	4.79	1.14	1.40	.74	0	0	30.09
1877–78	0	1.21	3.78	1.74	15.74	17.76	10.18	2.78	.59	0	0	0	53.78
1878–79	.68	2.09	2.54	.75	10.72	11.51	18.07	7.08	3.08	.30	0	0.08	56.90
1879–80	0	2.79	6.54	8.86	6.40	4.83	4.07	2.33	6.23	.09	0	0	42.14
1880–81	0	.04	.30	22.69	19.20	8.50	3.33	1.85	.05	1.50	0	0	57.46
1881–82	1.25	3.71	3.52	8.21	6.03	6.30	7.96	5.27	1.18	0	0	0	43.43
1882–83	1.88	7.88	4.78	2.83	3.05	2.97	9.25	2.38	5.77	0	0	0	40.79
1883–84	1.44	3.03	1.48	2.31	7.80	10.27	13.98	10.98	1.00	2.30	0	0	54.59
1884–85	.98	3.30	.05	28.39	3.65	1.76	.83	3.17	.16	.90	0	0	43.19
1885–86	2.65	0	19.27	6.36	12.40	1.43	4.83	11.38	1.09	0	0	0	59.41
1886–87	0	1.66	.67	5.46	3.38	15.72	1.69	6.54	.64	.52	0	0	36.28
1887–88	.26	0	1.38	6.85	11.81	2.59	5.22	.50	.38	2.26	.08	0	31.33
1888–89	.55	0	4.29	8.70	.64	1.08	12.95	3.87	7.21	.40	0	0	39.69
1889–90	0	12.49	8.76	21.08	18.64	10.02	13.69	3.52	3.10	.02	0	0	91.32
1890–91	1.95	0	0	5.51	1.54	13.70	6.22	2.98	2.06	1.27	.90	0	36.13
1891–92	.21	1.00	1.76	10.26	4.70	7.15	6.61	6.37	6.49	0	0	0	44.55
1892–93	.23	2.72	13.44	11.22	7.31	6.83	12.40	5.80	1.30	0	T.	0	61.25
1893–94	1.64	1.49	8.77	5.55	11.24	11.72	2.96	1.67	3.46	2.05	T.	.03	50.58
1894–95	1.01	4.91	1.38	16.55	22.26	6.18	5.01	3.38	3.46	0	.25	.24	64.63
1895–96	3.87	.02	1.17	7.27	20.34	.93	6.94	12.47	4.87	.13	.02	.13	58.16
1896–97	1.53	1.72	13.65	5.78	3.65	14.40	8.47	2.25	.10	.62	.04	.03	52.24
1897–98	.51	3.07	4.56	3.97	1.44	8.36	.52	(.90)	2.53	1.27	T.	T.	27.13
1898–99	.61	2.08	4.31	2.73	10.76	.47	19.60	1.70	2.72	.83	0	.42	46.23
1899–1900	0	10.33	11.58	11.35	6.90	2.54	7.40	3.92	1.31	.65	.04	.03	56.05
28-year mean													49.41

Record of precipitation at Malakoff mine, Nevada County.

[Latitude, 39° 22′; longitude, 120° 50′; elevation, 3,200 feet. Authority, R. D. Wheeler.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1886–87	0	2.39	0.80	5.32	5.06	18.12	2.27	7.52	0.89	0.49	0	0	42.86
1887–88	0.64	0	1.68	8.26	12.14	2.67							[a]25.39
1894–95					24.40	7.28	7.01	5.18	6.03	0	0.14	0.41	[a]50.45
1895–96	6.22	.56	2.27	7.36	24.11	1.36	10.20	17.78	6.61	T.	.06	.15	76.68
1896–97	1.90	2.33	17.42	7.02									[a]28.67
2-year mean													59.77

[a] Year incomplete.

Record of precipitation at Nevada City, Nevada County.

[Latitude, 39° 16′; longitude, 121° 2′; elevation, 2,500 feet. Authority, J. S. Brown.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1863-64	0	0	1.00	3.50	0.90	0.50	5.38	3.25	2.75	0	0	0.75	18.03
1864-65	0	0	17.65	17.42	9.71	4.38	2.09	1.75	1.31	0	0	0	53.71
1865-66	0.59	2.03	14.29	1.95	15.47	5.60	14.24	.59	4.50	0	0	0	59.26
1866-67	0	0	9.61	32.70	14.21	10.00	6.23	6.88	1.93	0	0	0	81.56
1867-68	1.91	3.63	16.11	41.95	11.01	6.36	23.30	7.22	1.50	2.27	0	0	115.26
1868-69	.34	.43	1.49	10.62	16.85	12.62	6.96	5.72	1.62	.04	0	0	56.69
1869-70	.15	.50	4.67	6.29	9.23	14.48	7.58	4.70	.65	.36	0.03	0	48.64
1870-71	0	3.82	4.32	5.32	11.08	6.23	5.41	5.55	3.26	.33	0	0	45.35
1871-72	0	.79	5.00	27.31	18.16	16.67	5.28	3.76	.17	1.08	0	0	78.22
1872-73	0	.55	4.05	12.25	2.82	12.40	1.96	2.47	2.20	0	0	0	38.70
1873-74	0	.67	1.35	24.27	11.16	7.32	12.20	4.51	1.32	.11	0	0	62.91
1874-75	0	3.06	15.08	.90	16.57	2.11	3.97	.27	1.56	2.43	0	0	45.95
1875-76	0	1.75	16.56	5.90	12.47	12.41	13.88	2.17	1.53	0	0	0	66.67
1876-77	.41	9.85	1.04	0	10.26	2.45	4.18	1.43	1.97	.72	.71	0	33.02
1877-78	0	1.35	4.31	2.65	17.62	16.61	10.05	2.80	1.05	0	0	0	56.44
1878-79	.69	2.32	2.88	.96	11.62	10.97	19.28	5.90	3.83	.43	0	.05	58.93
1879-80	0	3.15	5.50	8.76	6.67	5.48	5.09	22.54	5.58	.15	0	0	62.92
1880-81	0	.06	.28	24.78	18.88	6.26	4.44	1.70	0	1.47	0	0	57.87
1881-82	1.38	3.03	2.53	9.14	7.29	5.42	9.21	4.39	.52	0	0	0	42.91
1882-83	2.22	7.65	5.34	3.87	2.39	3.06	14.27	2.98	6.92	0	0	0	48.70
1883-84	1.28	3.60	1.62	2.84	9.08	12.01	14.70	12.07	1.67	2.47	.07	0	61.41
1884-85	1.87	3.61	0	27.92	4.39	1.69	.53	3.23	.21	1.36	0	0	44.81
1885-86	1.62	0	21.55	6.77	13.66	1.54	6.92	12.49	1.23	0	0	.07	65.85
1886-87					3.51	12.64	4.80	7.24	.70	.37	0	0	[a] 29.26
1887-88	.71	0	1.70	7.53	11.32	3.52	7.14	.68	.42	2.40	0	0	35.42
1888-89	.06	0	4.69	8.44	T	2.59	14.68	5.20	7.62	.58	.08	0	43.94
1889-90	0	13.05	8.55	24.50	24.05	10.07	13.40	3.11	3.35	.01	0	0	100.09
1890-91	2.04	.04	.04	6.38	2.18	18.66	3.64	2.93	1.92	.73	0	0	38.56
1891-92	.04	.90	1.42	9.56	6.48	6.04	7.27	7.17	5.80	.20	0	T.	44.88
1892-93	.26	.95	13.87	14.19	8.02	8.29	12.75	6.22	1.33	0	T.	0	65.88
1893-94	1.71	1.25	7.78	5.23	11.71	10.85	3.26	2.17	3.54	1.85	0	T.	49.35
1894-95	1.21	4.83	1.38	20.61	22.87	5.53	5.12	3.82	3.42	0	.15	.29	69.23
1895-96	3.36	0	1.87	6.14	19.61	.99	7.39	13.63	4.88	T.	.05	.05	57.97
1896-97	1.55	2.18	12.63	6.46	4.38	13.63	9.13	2.08	.22	.82	0	T.	53.08
1897-98	.60	3.36	4.38	3.17	1.92	9.91	.87	.95	2.73	1.27	0	T.	29.16
1898-99	.35	1.96	3.49	2.27	9.12	.49	15.88	1.52	2.61	.91	0	.29	38.91
1899-1900	0	10.24	10.85	10.27	7.81	2.36	7.51	4.83	1.90	.03	T.	0	55.80
1900-1901	.55	5.52	9.22	4.00	11.52	13.12	2.35	5.59	1.29	0	T.	.04	53.20
1901-2	3.36	4.16	5.45	5.35	1.91	18.28	5.02	4.66	1.47	.24	0	0	49.90
38-year mean													54.98

[a] Year incomplete.

NOTE.—Record from January, 1887, to February, 1892, inclusive, from J. F. Colley.

Record of precipitation at North Bloomfield, Nevada County.

[Latitude, 39° 22′; longitude, 120° 54′; elevation, 3,160 feet. Authority, H. C. Perkins and W. H. Radford.]

Year.	Sept.	Oct.	Nov	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1870-71	0	1.61	3.24	4.31	7.54	5.94	5.03	4.36	3.36	0.12	0	0	35.51
1871-72	0	.83	6.20	25.19	12.71	18.22	5.73	3.84	1.39	.41	0	0	74.52
1872-73	0.16	.53	4.47	11.77	4.16	11.09	2.50	2.40	1.57	0	0.10	0	38.75
1873-74	0	.67	3.37	19.00	15.17	7.08	11.16	4.04	1.78	.25	0	0.02	62.54
1874-75	.06	4.88	13.52	1.21	.15	.88	3.56	.30	2.68	.63	0	0	27.87
1875-76	0	2.09	15.53	7.64	10.98	10.20	13.02	4.03	1.06	.01	1.76	.01	66.33
1876-77	.31	10.46	.85	0	9.98	2.89	4.92	3.07	2.66	.91	0	0	36.05
1877-78	0	1.10	4.22	1.96	15.72	16.97	9.23	2.44	.95	0	0	0	52.59
1878-79	0	3.34	3.72	1.18	10.00	9.49	16.62	6.69	3.84	.64	0	.24	55.76
1879-80	0	3.03	6.43	13.57	5.96	5.66	5.45	23.31	5.63	0	0	0	69.04
1880-81	0	0	.41	21.10	19.46	12.13	4.92	2.59	1.33	1.57	0	0	63.51
1881-82	1.75	3.86	4.05	8.73	8.02	6.77	10.02	5.39	1.82	0	0	0	50.41
1882-83	2.74	6.86	5.72	3.59	3.69	3.94	10.45	3.39	0	0	0	0	40.38
1883-84	1.79	3.66	1.48	2.84	9.21	10.02	15.65	10.31	2.66	4.03	0	0	61.65
1884-85	1.98	3.43	0	37.21	3.65	1.91	.79	3.62	.71	2.14	0	0	55.44
1885-86	2.55	0	20.23	7.98	13.49	1.78	2.18	12.26	1.15	0	0	0	61.62
1896-97	1.90	2.33	17.42	7.02	5.06	16.57	11.16	3.70	.20	1.45	0	.11	66.92
1897-98	.57	5.05	6.12	5.41	2.28	13.03	.79	1.18	4.47	1.70	T	T	40.60
1898-99	.58	2.87	5.66	4.10	10.88	1.01	18.24	1.98	3.91	.65	0	.67	50.55
1899-1900	0	14.52	13.33	13.09	9.32	5.20	9.64	6.82	2.44	T	.01	0	74.37
1900-1901	.95	8.32	10.99	4.95	7.73	13.46	2.97	6.27	1.73	0	T	T.	57.37
1901-2	4.51	3.98	4.68	5.87	1.60	18.04	6.40	5.29	1.70	.19	.09	.04	52.39
22-year mean													54.28

Record of precipitation at Truckee, Nevada County.

[Latitude, 39° 19′; longitude, 120° 01′; elevation, 5,820 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1869-70	.....	.....	.....	.....	.....	6.18	4.35	0.12	2.40	0.80	1.30	.....	[a] 15.15
1870-71	0	0	0.51	1.67	4.80	4.23	3.18	2.00	.28	.35	0	0	17.02
1871-72	0.20	0.02	5.35	16.23	3.42	10.49	3.63	4.11	.60	.30	0	0	44.35
1872-73	0	.40	.60	3.74	3.78	9.55	1.69	1.36	.55	0	T.	0	21.67
1873-74	0	.11	.42	8.70	9.54	6.15	9.35	2.61	.68	.11	.56	0.07	38.30
1874-75	.04	2.44	3.54	.60	8.50	.20	1.20	.90	0	1.81	.40	.03	19.66
1875-76	T.	.62	8.94	4.90	9.85	5.50	6.95	1.83	.84	.01	.05	.03	39.52
1876-77	.03	3.64	.07	.05	9.45	.39	1.84	1.03	1.12	.36	0	0	17.98
1877-78	.04	0	1.66	.24	5.97	11.80	2.07	.80	1.17	.10	0	.28	24.13
1878-79	.23	.75	2.14	.50	7.70	2.68	5.25	1.55	.45	0	0	0	21.25
1879-80	.07	1.40	3.78	4.98	2.95	4.65	4.65	12.74	2.50	0	.16	0	37.88
1880-81	0	0	.45	9.51	5.71	2.13	1.86	.49	.40	1.26	.18	0	21.99
1881-82	.25	2.50	2.70	3.80	6.40	4.95	12.05	1.89	.85	.98	.60	0	36.97
1882-83	0	.85	1.04	.80	1.55	3.05	1.65	2.19	1.13	0	.53	0	12.79
1883-84	.28	2.46	2.50	1.62	6.65	11.20	5.38	3.90	.14	1.02	0	.10	35.25
1884-85	.78	1.50	0	13.14	1.80	.54	.56	2.04	.08	0	0	.25	20.69
1885-86	.47	0	6.95	2.22	7.08	.50	2.90	1.78	.60	.56	.89	0	23.95
1886-87	T.	.85	1.10	2.29	3.43	12.25	.36	2.00	2.04	.37	.40	T.	25.09
1887-88	0	0	.30	4.80	2.35	0	0	T.	.70	.80	.72	.20	9.87
1888-89	.28	0	2.38	1.58	.80	1.40	2.51	1.01	4.51	0	0	0	14.47
1889-90	0	3.13	3.29	2.51	16.20	8.90	7.29	.45	1.44	0	0	.22	43.43
1890-91	.80	.45	0	3.70	1.22	8.36	3.92	2.17	2.90	.46	0	0	23.98
1891-92	.98	.05	.45	6.34	2.65	2.80	3.00	2.96	4.20	.95	0	0	24.38
1892-93	.29	.37	5.73	8.15	5.44	8.02	5.18	3.73	1.79	0	0	0	38.70
1893-94	1.22	.35	3.96	2.82	8.06	10.95	2.65	2.15	1.05	T.	0	0	33.21
1894-95	.13	1.12	.60	13.95	11.13	1.92	1.72	.50	2.40	0	0	0	33.47
1895-96	1.32	.34	.50	2.96	7.07	.40	4.67	9.36	.54	0	.15	.34	27.65
1896-97	.32	.40	3.86	2.50	2.35	7.97	2.84	.30	T.	.18	0	0	20.72
1897-98	T.	.55	3.20	3.15	1.05	3.65	2.05	.25	.30	0	0	0	14.20
1898-99	.40	.06	2.95	1.50	7.80	2.70	9.50	1.10	.75	0	0	.92	27.68
1899-1900	0	6.49	2.80	1.80	2.63	.80	4.20	1.90	.80	1.01	0	0	22.43
1900-1901	0	1.02	2.50	2.70	5.00	7.97	2.50	1.80	.70	0	0	0	24.19
1901-2	.50	2.78	3.63	1.55	1.10	3.30	5.60	1.28	.55	0	.45	1.10	21.84
32-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26.21

[a] Year incomplete.

NOTE.—During July, 1902, there was also 3 feet of snow at Truckee.

Record of precipitation at Alta, Placer County.

[Latitude, 39° 13′; longitude, 120° 49′; elevation, 3,612 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1869-70	.....	.....	.....	.....	.....	13.75	6.56	3.73	1.32	0.66	.....	.....	[a] 26.02
1870-71	0	0	2.75	3.94	5.21	5.45	7.03	3.50	1.50	0	0	0	29.35
1871-72	0	0	T.	6.50	11.25	13.85	.45	.38	0	0	0	0	32.43
1872-73	0	0.25	.19	6.50	1.65	10.00	.95	3.03	0	0	0	0	22.57
1873-74	0.40	0	.90	15.59	12.66	7.17	3.76	5.75	1.27	0	0	0	47.50
1874-75	0	3.92	12.86	.09	13.17	.01	3.40	.40	.12	2.00	0	0	35.97
1875-76	0	.02	18.52	8.30	7.70	4.72	9.08	1.07	1.80	0	0.02	0	51.23
1876-77	0	7.00	.70	0	10.00	2.35	6.10	2.60	2.61	.80	0	0	32.16
1877-78	0	1.70	3.90	1.00	9.10	14.80	11.65	2.50	.33	0	0	0	44.98
1878-79	.60	2.96	4.18	1.00	12.80	13.10	24.30	7.73	2.45	0	0	0	69.12
1879-80	0	1.50	9.53	10.02	2.70	4.90	3.10	11.60	2.90	0	0	0	46.25
1880-81	0	0	1.00	13.80	21.00	11.80	3.50	.50	0	0	0	0	51.60
1881-82	1.12	4.50	5.60	13.60	5.93	6.40	15.40	3.20	1.15	.80	0	0	57.70
1882-83	2.70	7.65	5.64	2.31	4.08	1.60	9.06	3.43	6.07	0	0	0	42.54
1883-84	.60	1.60	2.05	3.10	3.50	8.60	7.00	5.20	.50	3.00	0	0	35.15
1884-85	.12	1.00	0	14.08	1.50	.60	.10	2.48	0	1.00	([b])	.....	[a] 20.88
14-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42.75

[a] Year incomplete.

[b] Alta ceased reporting after June, 1885.

Record of precipitation at Auburn, Placer County.

[Latitude, 38° 53′; longitude, 121° 05′; elevation, 1,363 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
869–70	------	------	------	------	------	7.31	3.92	2.63	0.45	0.81	0	0	[a] 15.12
870–71	0	0	0	0.46	7.21	2.36	1.85	3.57	2.06	0	0	0	17.51
871–72	0	0.54	2.80	13.55	6.80	9.35	3.59	2.50	.65	.22	0	0	40.00
872–73	0	.38	3.13	8.43	3.74	7.44	.53	1.22	.32	0	0	0	25.19
873–74	0	.34	1.25	11.97	7.46	4.14	6.26	2.56	.57	0	0	0	34.55
874–75	0	1.57	9.64	.82	10.00	.44	2.73	.10	.61	1.82	0	0	27.73
875–76	0	.85	11.39	6.05	7.56	5.62	10.10	1.97	.61	0	0.41	0.21	44.77
876–77	0	4.52	.65	0	6.94	1.47	2.14	.72	1.53	.27	0	0	18.24
877–78	0	.99	2.46	1.55	10.61	10.19	7.60	1.75	.98	0	0	0	36.13
878–79	0.50	.89	1.53	.91	6.34	7.16	8.78	5.94	2.43	.46	0	0	34.94
879–80	0	2.33	3.82	7.88	3.13	4.90	2.62	13.02	3.85	0	0	0	41.55
880–81	0	0	.25	13.91	9.61	8.20	2.43	1.38	0	1.40	0	0	37.18
881–82	.92	2.72	3.01	5.87	4.60	4.99	6.05	4.63	.53	.28	0	0	33.60
882–83	.84	5.19	4.08	1.65	2.86	1.06	5.19	.70	4.07	0	0	0	25.64
883–84	1.70	2.51	1.00	2.52	5.33	7.63	10.17	8.02	.85	1.23	0	0	40.96
884–85	.56	2.25	0	16.37	1.74	1.27	.57	2.10	0	.70	0	0	25.56
885–86	.64	0	15.24	4.05	8.25	0	4.10	9.38	.65	0	0	0	42.31
886–87	0	.89	1.26	4.88	2.04	12.38	1.50	4.34	.30	0	0	T.	27.59
887–88	1.09	0	1.22	4.90	7.07	1.40	3.25	.80	.40	1.55	0	(T.)	21.68
888–89	.30	0	4.20	5.82	.33	.52	9.57	1.36	4.65	0	0	0	26.75
889–90	0	5.75	4.85	11.94	8.97	3.96	8.08	2.83	2.30	0	0	0	48.68
890–91	2.63	.14	0	5.13	.88	6.80	5.40	2.23	.88	.69	0	0	24.78
891–92	0	1.33	.95	7.36	4.00	4.91	5.96	3.11	4.55	0	0	0	32.17
892–93	.15	1.76	6.13	8.99	5.33	4.74	9.20	3.71	.78	0	0	0	40.79
893–94	.70	1.11	5.32	3.88	6.96	9.89	1.95	1.35	2.77	1.38	T.	T.	35.31
894–95	.67	3.87	7.09	13.56	12.99	4.14	3.09	3.38	1.88	0	T.	.13	50.80
895–96	2.04	.12	1.04	3.39	11.88	.49	6.21	7.66	2.42	.43	.14	.25	36.07
896–97	------	------	------	------	2.78	11.40	8.05	1.51	.28	.17	0	T.	[a] 24.19
897–98	.20	2.83	2.22	3.50	1.13	6.44	.32	.49	2.26	.97	T.	0	20.36
898–99	.26	1.75	3.59	2.75	4.78	.17	13.25	.51	1.28	1.43	0	.03	29.80
899–1900	0	5.94	9.00	5.47	5.47	2.11	3.69	3.42	2.19	T.	0	0	37.29
900–1901	.45	4.50	6.38	2.01	7.82	8.84	1.25	4.83	.88	0	T.	0	36.96
901–02	2.39	5.71	4.86	3.95	1.70	12.72	4.80	3.10	.80	.50	T.	.02	40.55
31-year mean	------	------	------	------	------	------	------	------	------	------	------	------	33.40

[a] Year incomplete.

Record of precipitation at Cisco, Placer County.

[Latitude, 39° 19′; longitude, 120° 33′; elevation, 5,939 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1869-70		.....	.....	.....	.....	13.46	3.70	0.65	0.40	.....	.....	0	[a]18.21
1870-71	0	1.20	2.80	4.40	6.40	8.40	2.40	3.05	4.95	0.85	0	0	34.45
1871-72	0.40	.20	6.20	24.89	6.50	12.55	3.98	6.05	1.14	1.03	0.53	T.	63.47
1872-73	0	.60	2.65	9.51	5.60	14.00	1.60	1.60	1.50	0	0	0	37.06
1873-74	0	.55	1.35	14.40	7.70	7.00	14.00	4.10	3.10	0	0	0	52.20
1874-75	.50	2.70	7.07	.50	8.40	.45	4.80	.90	.82	2.05	0	0	28.19
1875-76	0	1.75	8.55	5.30	18.50	22.20	17.20	.70	1.20	T.	0	0	75.40
1876-77	0	2.48	4.20	0	7.20	.30	.53	2.87	3.71	.80	0	0	22.09
1877-78	0	.60	4.52	1.30	9.60	11.85	2.00	2.00	4.00	0	0	0	35.87
1878-79	.20	1.45	1.85	1.25	9.30	10.34	16.42	5.50	2.90	.30	.03	0.04	49.58
1879-80	0	2.10	8.17	8.92	4.80	7.10	7.60	11.90	3.90	.03	0	0	54.52
1880-81	.01	.82	.62	16.33	33.46	12.91	6.10	4.81	0	3.30	0	0	78.36
1881-82	2.16	2.93	3.60	8.76	11.71	8.50	25.30	5.60	.91	.48	0	0	69.95
1882-83	.83	8.28	3.75	2.88	.90	4.85	9.25	3.50	6.96	0	0	0	41.20
1883-84	0	1.50	2.20	2.70	8.40	12.00	14.65	10.10	0	3.45	0	0	55.00
1884-85	1.40	2.32	0	25.05	2.30	1.28	2.20	3.95	.30	.95	0	0	39.75
1885-86	.50	0	17.05	4.87	14.75	2.40	7.49	7.50	1.45	0	0	0	55.92
1886-87	0	1.45	1.05	6.10	4.90	22.85	.80	3.95	.40	0	T.	0	41.50
1887-88	.15	0	1.60	8.80	9.75	2.72	6.10	2.20	1.50	1.20	0	0	34.02
1888-89	.68	.15	5.38	9.88	1.40	9.97	2.70	1.65	8.10	.47	0	0	40.38
1889-90	0	11.72	9.54	25.57	22.90	14.90	8.70	1.50	2.50	.30	0	0	97.63
1890-91	3.11	.55	0	7.90	2.20	11.88	6.45	3.70	2.25	3.75	.20	0	41.99
1891-92	.21	1.00	1.76	2.83	5.10	7.61	8.55	6.30	8.30	1.40	0	0	43.06
1892-93	.30	.95	12.60	11.20	3.20	8.50	7.78	0	1.60	T.	0	0	46.13
1893-94	0	0	5.38	8.80	16.45	18.65	5.30	3.55	2.60	0	0	0	60.73
1894-95	.10	.90	1.50	21.60	.....	.....	.....	.....	.....	.....	.....	.....	[a]24.10
1895-96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1896-97	.....	.....	.....	.....	3.90	10.20	15.20	7.00	.....	.....	.....	0	[a]36.30
1897-98	.49	2.48	14.00	.50	3.80	5.60	1.30	9.00	3.40	1.10	0	0	42.67
1898-99	.83	2.10	4.80	1.10	10.70	2.60	19.56	1.30	2.10	2.10	0	.50	47.69
1899-1900	0	12.83	13.47	12.14	8.40	6.43	9.56	4.85	1.53	.60	.15	0	70.96
1900-1901	.33	7.55	10.43	7.50	10.95	22.45	4.70	4.40	3.25	0	0	0	71.58
1901-02	2.41	3.27	5.38	8.80	1.54	14.17	5.40	1.80	.90	.40	T.	T.	44.07
29-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50.88

[a] Year incomplete.

Record of precipitation at Colfax, Placer County.

[Latitude, 39° 08′; longitude, 120° 57′; elevation, 2,421 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Apr.	May.	June.	July.	Aug.	Total.
869-70	.....	.....	.....	.....	.....	5.55	5.41	3.19	0.25	.....	0	0	[a] 14.40
870-71	0	1.21	2.58	3.94	7.24	4.85	4.30	4.03	2.55	0.13	0	0	30.83
871-72	0	0	4.25	9.80	10.02	13.68	4.69	3.40	.61	.40	0	T.	46.85
872-73	T.	0	3.99	10.48	2.90	11.12	1.24	1.81	2.04	0	T.	0	33.58
873-74	0	0	2.27	18.84	10.93	6.62	10.12	3.53	1.31	0	0	0	53.62
874-75	0	3.36	13.89	1.12	12.32	.19	3.23	.20	1.90	0	0	0	36.21
875-76	0	.95	14.84	7.10	10.40	7.20	14.39	3.23	1.42	T.	0	0	59.53
876-77	0	7.98	.62	0	9.29	1.76	4.36	1.36	1.67	.57	0	T.	27.61
877-78	0	.95	3.38	1.76	13.10	12.21	9.22	1.79	.42	T.	0	0	42.83
878-79	0.56	0	2.08	.85	8.73	8.87	14.62	6.57	2.91	.27	0	0	45.46
879-80	0	2.94	4.68	9.16	4.53	6.60	2.85	21.09	4.29	0	0	0	56.14
880-81	0	T.	0	16.47	15.59	9.30	3.83	1.53	T.	1.31	0	0	48.03
881-82	1.63	1.38	3.40	8.01	9.09	7.11	6.97	3.98	1.13	.13	0	0	42.83
882-83	.40	2.96	4.03	3.60	1.68	3.23	7.98	2.93	5.92	0	0	0	32.73
883-84	1.08	2.97	1.34	2.32	7.57	9.73	12.27	10.94	1.38	3.01	0	0	52.61
884-85	.80	2.55	T.	23.60	2.85	1.66	.68	2.29	0	1.18	0	0	35.61
885-86	.62	0	15.48	6.77	12.17	.34	3.69	10.86	1.08	0	0	0	51.01
886-87	0	1.96	.46	6.12	2.99	9.24	1.51	4.92	.72	0	0	0	27.92
887-88	.68	.84	1.61	6.00	13.28	2.18	2.80	.95	.17	2.69	0	0	31.20
888-89	.25	.10	3.28	9.57	.50	.90	13.90	3.00	9.14	.25	0	0	40.89
889-90	0	9.95	9.60	21.85	17.90	8.00	14.70	3.95	3.85	0	0	0	89.80
890-91	2.75	T.	0	4.54	1.95	14.60	9.60	2.45	1.70	2.60	0.90	0	40.89
891-92	0	.40	1.06	11.04	4.85	7.55	7.45	5.73	6.14	.60	0	0	44.82
892-93	.53	2.20	1.55	16.95	7.62	5.68	12.80	4.22	1.30	0	0	0	52.85
893-94	.85	1.23	9.32	5.08	13.43	9.76	3.60	4.48	3.45	2.45	0	0.03	54.08
894-95	1.00	5.75	0	24.17	20.57	5.55	4.76	0	4.80	0	0	.28	66.88
895-96	2.29	0	1.77	8.85	23.23	.93	6.36	16.15	5.39	0	0	.10	65.07
896-97	1.64	1.62	14.39	5.58	4.15	15.86	7.46	0	0	.85	0	0	51.55
897-98	T.	3.86	3.28	5.80	1.80	9.61	1.89	1.38	2.98	1.50	0	0	32.10
898-99	.36	1.42	4.46	3.01	9.29	.87	20.73	1.16	2.41	1.72	0	.30	45.73
899-1900	0	9.63	13.06	12.83	6.41	4.38	7.79	5.74	3.12	.10	0	0	63.06
900-1901	1.00	7.33	12.27	3.96	13.91	15.75	2.65	6.55	1.91	0	0	0	65.33
901-02	2.95	4.45	4.82	5.45	.98	18.14	7.11	4.84	.90	.70	0	.02	50.36
32-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	47.44

[a] Year incomplete.

Record of precipitation at Emigrant Gap, Placer County.

[Latitude, 39° 17′; longitude, 120° 40′; elevation, 5,230 feet. Authority, Pacific Railway System.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1869-70							6.39	3.16	0.46	0.04	0	0	[a]10.0[illegible]
1870-71	0	1.63	3.00	6.30	5.75	7.15	2.75	2.80	3.34	.41	0	0	33.1[illegible]
1871-72						14.58	6.08	4.44	.27	0	0	0	[a]25.3[illegible]
1872-73	0	.50	.20	15.65	6.30	18.50	2.70	1.58	3.34	0	0.01	0	48.7[illegible]
1873-74	0	1.25	2.70	17.30	10.02	10.42	22.12	.50	.63	.63	0	0	65.5[illegible]
1874-75	0	2.00	1.00	.40	5.85	.20	2.90	1.00	2.50	1.50	0	0	17.3[illegible]
1875-76	0	0	9.10	3.90	14.80	5.70	7.30	2.70	1.50	.80	.30	0	46.1[illegible]
1876-77	0	1.75	.60	0	4.30	.05	.50	.50	1.20	.83	T.	0	9.7[illegible]
1877-78	0	.32	5.44	1.62	15.72	16.87	7.17	3.87	.53	0	0	0	51.5[illegible]
1878-79	.65	2.25	3.04	.75	15.43	13.21	21.69	7.76	2.81	.34	0	0	67.9[illegible]
1879-80	0	3.30	5.11	12.33	10.10	9.88	9.75	21.76	3.42	.06	0	0	75.7[illegible]
1880-81	0	0	.30	15.38	25.69	5.42	5.49	4.63	.37	2.54	0	0	59.8[illegible]
1881-82	1.70	6.68	2.90	5.64	10.03	9.46	16.60	2.60	1.55	.49	0	0	57.5[illegible]
1882-83	.60	7.95	2.15	3.31	3.22	4.00	10.06	3.30	4.90	0	0	0	39.4[illegible]
1883-84	1.25	3.66	1.20	3.15	8.22	10.20	15.18	10.84	2.10	2.77	0	0	58.5[illegible]
1884-85	.91	1.93	0	31.20	2.68	2.15	.40	3.89	.20	1.83	0	0	45.1[illegible]
1885-86	.53	0	18.69	7.38	18.28	1.97	6.90	11.90	2.73	T.	0	0	68.3[illegible]
1886-87	0	2.96	.40	8.00	4.12	18.80	2.03	6.17	1.02	1.14	0	0.13	44.7[illegible]
1887-88	.05	3.00	1.50	7.70	17.05	3.92	5.42	3.30	2.23	3.04	.62	0	47.8[illegible]
1888-89	.10	0	1.77	7.39	1.10	1.10	5.69	2.29	8.61	.38	0	0	28.4[illegible]
1889-90	0	11.81	11.41	20.85	16.90	9.80	13.15	1.72	3.37	0	0	0	89.0[illegible]
1890-91	.32	.65	0	6.20	1.70	7.88	4.55	3.15	2.70	2.40	0	0	29.5[illegible]
1891-92	0	.20	2.40	12.90	5.42	7.46	5.70	3.00	5.60	.70	0	0	43.3[illegible]
1892-93	.10	1.70	15.02	19.97	5.50	6.38	10.05	5.71	.69	0	0	0	65.1[illegible]
1893-94	1.20	2.00	5.95	9.19	10.10	15.50	18.00	2.62	1.60	2.29	0	0	68.4[illegible]
1894-95	0	2.41	.90	9.19	17.90	1.40	.50	1.60	1.20	0	0	0	35.1[illegible]
1895-96	.31	2.41	1.90	4.00	17.40	7.88	8.00	11.50	1.20	.30	T.	0	54.9[illegible]
1896-97					2.70	2.96	12.80	1.40	T.			0	[a]19.8[illegible]
1897-98			5.56				1.20	1.10					[a]7.8[illegible]
25-year mean													50.0[illegible]

[a] Year incomplete.

Record of precipitation at Iowa Hill (Strawberry Flat), Placer County.

[Latitude, 39° 07′; longitude, 120° 49′; elevation, 2,825 feet. Authority, C. F. Macy.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
78-79	.....	.....	.....	.....	12.50	12.50	18.25	7.87	3.25	0.25	0	0	[a]54.62
79-80	0	3.50	3.63	13.35	5.90	6.10	7.88	18.87	6.25	0	0	0	64.58
80-81	0	.75	.75	20.80	20.75	10.50	4.62	3.15	.13	2.12	0	0	63.57
81-82	2.50	4.25	3.90	10.56	8.92	6.80	10.43	7.59	1.55	.73	0	0	57.23
82-83	.35	8.50	6.63	2.69	4.37	4.24	10.63	3.67	7.22	0	0	0	48.30
83-84	.75	4.54	2.02	3.75	8.05	11.26	16.50	13.22	1.60	2.52	0	0	64.21
84-85	1.60	2.43	0	24.22	3.03	1.48	.68	2.93	.05	1.60	0	0	38.02
85-86	1.20	0	15.82	6.14	10.89	.68	6.46	12.19	1.87	0	0	T.	55.25
86-87	0	2.28	.80	5.75	3.61	15.61	2.23	6.55	.78	0	0	0.05	37.66
87-88	.48	0	.95	6.52	11.73	2.41	4.59	1.47	1.14	2.60	0.06	T.	31.95
88-89	.35	0	3.78	8.14	.58	.71	12.12	4.20	8.26	.22	.05	.06	38.47
89-90	0	9.20	8.49	21.04	20.87	10.74	14.12	3.02	3.48	.08	0	T.	91.04
90-91	2.29	.35	0	7.34	1.96	10.52	8.28	3.55	2.03	2.13	.83	0	39.28
91-92	.30	.98	1.51	11.64	4.01	5.36	7.11	6.02	6.57	.41	0	0	43.91
92-93	.51	2.51	8.21	11.88	6.91	5.80	12.94	6.69	1.44	0	T.	0	56.89
93-94	1.81	1.35	8.30	5.37	11.07	12.25	4.20	2.10	4.03	1.64	T.	.51	52.63
94-95	.78	4.06	1.48	17.57	18.64	5.57	4.60	3.93	3.92	0	.03	.27	60.85
95-96	2.91	.17	1.61	5.87	17.77	.70	10.93	14.01	4.58	0	.11	.06	58.72
96-97	1.00	.49	13.42	5.13	3.44	15.83	11.33	2.15	.15	1.32	0	0	54.26
97-98	.45	3.09	3.49	5.31	2.04	8.10	1.68	.99	2.83	1.49	T.	0	29.47
98-99	.44	1.87	4.03	2.84	6.93	.83	18.06	1.15	2.41	1.15	0	.32	40.03
99-1900	0	9.18	9.08	8.15	4.43	3.39	6.40	4.59	2.59	.10	.05	0	47.96
00-1901	.99	5.67	9.65	3.16	9.94	12.61	1.98	6.55	.96	0	T.	.07	51.58
01-2	4.12	3.98	4.72	6.08	1.15	15.75	7.54	3.90	1.04	.66	0	.15	49.09
3-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	51.08

[a] Year incomplete.

Record of precipitation at Summit, Placer County.

[Latitude, 39° 19′; longitude, 120° 27′; elevation, 7,017 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1870-71	0	0.24	3.22	5.11	8.44	8.39	3.38	2.77	0.31	0.89	0	0	32.75
1871-72	0.33	.40	9.33	28.88	4.44	17.61	6.55	6.22	.33	0	0	0	74.09
1872-73	0	0	0	7.10	2.56	18.00	6.72	2.72	1.52	0	0	0	38.62
1873-74	0	0	0	12.68	5.00	0	0	2.22	3.33	.11	0	0	23.34
1874-75	0	3.80	2.63	.94	8.65	13.89	5.22	.89	1.58	2.64	0	0	40.24
1875-76	0	0	7.22	7.78	16.28	9.67	15.33	3.33	1.11	0	0	0	60.72
1876-77	.56	8.18	.53	.22	17.89	.64	3.82	.31	4.03	.02	1.26	0.10	37.56
1877-78	.30	.59	3.69	2.50	14.11	13.58	3.38	2.67	1.61	0	0	.09	42.52
1878-79	.11	1.35	.89	1.66	11.51	9.33	23.37	5.02	2.83	.11	0	0	56.51
1879-80	0	1.55	6.22	17.00	7.33	8.33	9.99	33.71	3.86	0	0	0	87.99
1880-81	0	0	.55	6.89	8.00	4.67	1.67	1.11	.05	.52	0	0	23.46
1881-82	.60	3.38	3.40	9.52	8.01	10.00	10.33	3.61	.66	0	0	0	49.51
1882-83	.75	13.26	4.39	5.50	1.11	2.88	8.50	3.77	3.66	0	0	0	43.82
1883-84	.10	1.06	1.33	3.55	8.44	14.11	10.11	14.00	.82	4.10	0	0	57.62
1884-85	1.10	3.13	0	9.40	1.40	.58	.10	4.88	1.00	.80	0	T.	22.39
1885-86	.05	0	13.60	3.00	13.90	1.40	7.80	6.40	.95	0	0	0	47.10
1886-87	0	3.10	1.70	5.75	6.25	20.70	1.40	5.80	.95	1.60	.10	T.	47.35
1887-88	T.	.07	1.50	11.60	9.20	1.29	8.05	2.30	1.04	3.72	3.50	.28	42.55
1888-89	0	0	1.90	5.26	1.00	1.50	9.55	1.90	6.30	.22	0	0	27.63
1889-90	0	5.65	6.80	18.50	19.20	11.60	14.00	0	.80	0	0	0	76.55
1890-91	0	0	0	7.40	1.50	1.38	5.10	4.60	1.10	0	0	0	21.08
1891-92	1.20	.05	.30	11.90	4.00	3.40	7.40	4.50	6.30	.20	0	0	38.25
1892-93	0	.60	8.80	9.50	7.90	10.80	14.50	9.20	0	0	0	0	61.30
1893-94	0	.30	0	6.00	15.50	15.25	3.40	4.30	2.40	0	0	0	47.15
1894-95	.95	1.28	.53	9.53	25.80	4.20	4.70	2.50	2.40	0	0	0	51.89
1895-96	.20	0	1.40	8.30	10.50	.70	9.70	18.20	5.40	0	.21	.02	54.63
1896-97	.40	.90	12.30	4.10	4.05	14.35	18.00	1.25	0	.70	0	0	56.05
1897-98	.03	2.50	26.50	4.20	4.00	7.10	5.20	.80	2.90	.90	0	0	54.13
1898-99	0	4.40	2.50	3.60	12.70	5.20	15.75	1.75	3.60	.70	0	1.00	51.20
1899-1900	0	16.05	9.15	7.90	5.25	4.75	8.15	4.80	3.97	.50	.25	T.	60.77
1900-1901	.95	3.50	6.90	3.50	11.30	14.20	4.50	5.50	1.00	0	0	0	51.35
1901-2	1.40	4.20	4.70	2.80	4.00	16.30	8.90	3.00	1.10	.30	0	1.00	47.70
32 year mean													47.74

Record of precipitation at Towles, Placer County.

[Latitude, 39° 18′; longitude, 120° 38′; elevation, 3,704 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
85–86	0.80	0	14.40	7.00	9.80	0.50	5.10	3.80	0	0	0	0	41.40
86–87	0	0.80	.80	3.00	4.35	11.60	1.10	1.20	T.	0	T.	0	22.85
87–88	0	0	.90	1.06	20.14	1.71	0	0	0	1.06	0.08	0	24.95
88–89	0	1.11	1.08	1.01	.45	.90	.60	0	0	0	0	0	5.15
89–90	0	6.03	4.11	11.40	19.40	14.60	3.00	0	1.00	0	1.00	0	60.54
90–91	.10	1.02	8.10	8.03	1.81	14.65	10.52	2.59	2.86	2.52	1.40	0	53.60
91–92	1.08	1.72	2.23	11.18	4.95	7.16	9.32	7.78	8.10	.75	0	0	54.27
92–93	.93	2.74	12.54	17.33	9.06	8.65	16.61	7.98	2.34	0	0	0	78.18
93–94	2.75	1.76	10.62	6.78	13.76	10.10	5.39	2.42	2.06	2.15	0	0	57.79
94–95	1.20	5.60	1.60	13.88	19.05	7.24	4.60	5.15	4.76	0	0	0	63.08
95–96	4.25	.80	2.16	7.61	21.34	1.08	14.03	15.66	7.21	0	T.	0	74.14
96–97	8.04	1.08	3.12	6.07	5.25	13.34	5.48	2.48	.30	1.30	0	0	46.46
97–98	.10	1.78	9.29	4.61	2.95	8.29	.50	.50	3.18	2.09	0	0	33.29
98–99	.48	2.85	5.35	3.36	8.54	.90	19.51	1.48	2.49	1.60	0	1.14	47.70
99–1900	0	9.08	10.90	10.64	8.04	19.06	3.07	1.02	.10	0	0	0	61.91
900–1901	.10	8.16	18.06	11.60	5.99	14.16	6.08	0	1.10	0	0	0	65.25
901–2	20.01	1.10	19.10	15.91	1.75	22.25	1.11	.50	1.52	0	0	0	82.25
7-year mean	------	------	------	------	------	------	------	------	------	------	------	------	51.54

Record of precipitation at Laporte, Plumas County.

[Latitude, 39° 41′; longitude, 120° 59′; elevation, 5,000 feet. Authority, Weather Bureau.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
893–94	------	------	------	------	------	------	------	3.05	2.00	3.49	T.	0.17	[a] 8.71
894–95	1.13	8.87	1.32	15.47	22.01	6.65	6.12	4.00	8.55	0	1.41	.29	75.82
895–96	8.42	.69	3.35	9.98	32.43	2.84	16.20	16.63	9.32	.09	.31	.25	100.51
896–97	2.29	3.09	23.87	12.88	6.04	17.92	13.51	3.12	0.71	3.94	0	T.	87.37
897–98	1.26	4.84	9.34	6.63	2.53	13.04	1.62	1.49	4.64	2.73	T.	.04	48.16
898–99	0.94	3.31	6.67	3.36	12.95	2.96	25.26	2.92	4.43	1.48	0	.82	64.83
899–1900	0	18.30	15.96	16.23	11.95	5.66	12.24	6.51	2.57	.36	.06	T.	89.84
900–1901	.61	13.02	14.30	8.79	17.25	18.35	6.24	7.48	2.09	T	T.	.05	88.18
901–2	5.26	4.82	9.10	8.16	2.64	33.50	10.09	9.59	2.28	.64	.02	T.	86.10
-year mean	------	------	------	------	------	------	------	------	------	------	------	------	80.10

[a] Year incomplete.

Record of precipitation at Mumford Hill, Plumas County.

[Latitude, 39° 58′; longitude, 121° 05′; elevation, 4,750 feet. Authority, J. A. Edman, Meadow Valley.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1876-77					11.40	5.00	5.13	2.50	3.00	1.72	0.52	0	a29.27
1877-78	0	1.10	3.05	2.10	18.15	26.52	9.44	2.10	1.85	0	.30	0.70	65.31
1878-79	2.10	2.75	5.15	3.75	12.38	12.62	30.15	6.53	3.60	1.13	0	.29	80.45
1879-80	0	4.01	7.20	14.16	10.06	7.96	5.18	23.54	6.42	0	0	.90	79.43
1880-81	0	0	.76	24.34	16.57	13.28	3.60	3.21	.84	.54	0	0	63.14
1881-82	1.36	3.28	4.32	11.23	9.94	8.60	10.75	7.48	2.05	0	0	0	59.01
1882-83													44.20
1889-90	1.59	18.77	10.83	29.40	31.33	18.44	20.25	6.33	2.00	0	0	0	138.85
1890-91	1.50	.75	1.10	8.18	2.00	22.65	7.90	3.17	2.39	1.95	1.25	0	52.84
1891-92	.51	1.50	2.06	13.60	5.45	5.12	5.40	6.35	6.03	0	0	0	46.01
1892-93	.32	2.61	22.70	24.98	11.47	13.07	13.89	8.43	3.23	.16	0	0	100.86
1893-94	1.79	1.27	9.46	4.40	17.46	16.48	7.08	3.94	2.85	2.26	0	1.45	68.44
1894-95	1.17	6.54	2.26	24.00	26.11	5.83	10.59	3.80	7.18	0	0	.27	87.75
1895-96	9.35	1.13	3.48	9.22	32.70	1.20	13.33	16.25	7.20	0	.08	.22	94.16
1896-97	1.43	2.53	16.64	11.13	5.44	13.80	12.07	1.59	.06	2.14	0	0	66.83
1897-98	.70	3.78	8.17	5.21	1.73	12.74	1.41	1.25	4.94	2.11	0	0	42.04
1898-99	.26	2.27	4.10	1.94	13.12	3.01	17.04	2.35	2.92	.64	0	1.64	49.29
1899-1900	0	15.38	13.09	11.89	10.99	3.10	8.95	6.24	1.63	.61	0	.05	71.93
1900-1901	.20	12.51	13.13	7.70	16.79	15.36	4.94	5.62	1.34	0	0	.50	78.09
1901-2	4.86	4.27	8.85	6.81	2.38	25.42	10.60	6.77	2.49	0	.13	.02	72.60
16-year mean													71.64

a Year incomplete.

Record of precipitation at Banning, Riverside County.

[Latitude, 33° 56′; longitude, 116° 55′; elevation 2,317 feet. Authority, Pacific Railway System.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1878-79	0	0	0	1.08	2.37	0.66	0	1.48	0	0	0	0	5.59
1879-80	0	0.02	2.84	4.55	.75	1.59	2.77	2.40	0	0	0	0	14.92
1880-81	0	.52	.87										a1.39
1898-99					2.70	.72	2.14	.08	0.01	0.48	0	0	a6.13
1899-1900	0	.69	2.23	.88	4.29	.05	1.19	2.22	1.80	0	0	0	10.35
1900-1901	0.10	.47	3.94	0	4.12	6.46	.81	.60	1.21	0	0	1.19	18.90
1901-2	0	1.17	.50	0	2.74	4.83	4.63	1.00	.06	T.	0.14	0	15.07
6-year mean													11.82

a Year incomplete.

Record of precipitation at Beaumont, Riverside County.

[Latitude, 33° 55′; longitude, 117° 00′; elevation, 2,550 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1887–88	.....	.....	.....	.....	1.39	1.18	5.78	0.87	0.40	0	0	0.50	[a]10.12
1888–89	0	0.30	3.92	4.19	1.15	1.95	5.27	.61	.29	0	0	0	17.68
1889–90	0	1.53	.67	11.09	3.71	4.74	1.13	1.15	1.05	0	0.15	.15	25.40
1890–91	1.04	0	.43	2.74	0	8.70	1.07	1.72	2.43	0	0	.87	19.00
1891–92	.48	0	.23	2.43	.96	3.53	3.18	.37	1.87	0	0	0	13.05
1892–93	0	0	1.65	1.95	2.97	2.66	9.67	.40	0	0	0	.18	19.48
1893–94	0	1.45	0	4.34	.30	2.09	.35	.32	.43	0	0	0	9.28
1894–95	.42	0	0	8.89	11.49	2.28	2.72	1.24	T.	0	0	0	27.04
1895–96	0	.14	1.90	.34	1.68	.65	4.48	0	.82	0	.25	.31	10.57
1896–97	0	2.24	1.05	.30	5.00	5.91	4.69	0	0	0	0	0	19.10
1897–98	0	0	0	.43	1.58	.75	1.95	1.00	3.00	0	0	0	8.71
1898–99	0	0	0	1.20	2.64	1.02	1.40	.35	.10	1.07	0	0	7.78
1899–1900	0	.88	2.85	.89	1.45	0	1.16	2.33	1.72	0	0	0	11.28
1900–1901	.25	.38	3.98	0	4.08	4.77	.35	.35	1.80	0	0	.51	16.47
1901–2	0	1.56	.43	0	2.51	3.59	4.14	1.07	.24	0	.05	0	13.59
14-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.60

[a] Year incomplete.

Record of precipitation at San Gorgonio Pass, Riverside County.

[Latitude, 33° 54′; longitude, 117° 02′; elevation, 2,560 feet. Authority, J. J. Ring and M. Murray.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1874–75	.....	.....	.....	0.40	1.00	0.60	.....	.....	0	T.	0	0	[a]2.00
1875–76	0.03	0	1.33	1.23	9.31	5.54	6.26	0.99	.20	0	0.03	0.12	25.04
1876–77	.19	.18	0	0	5.55	2.03	3.93	2.59	3.93	0	.30	T.	18.70
1877–78	.03	1.30	.80	4.28	6.03	10.49	4.40	6.81	1.33	0.26	.03	.20	35.96
1878–79	0	0	.97	.92	2.88	1.78	.55	3.23	.01	.62	0	.22	11.18
1879–80	0	1.00	4.10	9.39	1.78	2.81	3.04	6.94	.14	0	T.	.09	29.29
1880–81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1881–82	0	.50	1.33	10.27	2.48	1.86	3.39	3.62	.35	0	.94	0	24.74
1882–83	0	.53	1.33	.42	3.30	7.29	4.38	4.21	.35	1.30	0	.62	23.73
1883–84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1884–85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1885–86	.....	.....	.....	.....	2.97	1.73	3.07	1.24	0	0	0	0	[a]9.01
1886–87	0	0	.58	3.36	.06	5.07	.08	2.94	.14	0	.07	0	12.30
1887–88	0	1.23	1.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	[a]2.74
8-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22.62

[a] Year incomplete.

Record of precipitation at Whitewater, Riverside County.

[Latitude, 33° 54′; longitude, 116° 39′; elevation, 1,123 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1877–78	0	0	0	1.30	1.40	0.98	0.45	2.35	0	0	0	0	6.48
1878–79	0	T.	.18	.46	1.30	.28	.34	.30	0	0	0	0	2.86
1879–80	0	0	1.62	2.08	.51	.42	.20	.12	0.01	0	0	0.25	5.21
1880–81	0	0.15	.34	1.70	0	0	2.25	.01	0	0	0	.46	4.91
1881–82	0	T.	0	0	0	.48	.20	.16	0	0	0	0	.84
1882–83	0	0	.57	0	.15	.34	.80	.55	0	0	0	0	2.41
1883–84	0	.78	0	1.92	1.10	6.96	3.05	0	0	0	0	0	13.81
7-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.22

NOTE.—Whitewater ceased reporting after August, 1884.

Record of precipitation at Sacramento, Sacramento County.

Latitude 38° 35′; longitude, 121° 30′; elevation, 71 feet. Authority, Signal Service and Weather Bureau.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1849-50	0.25	1.50	2.25	12.50	4.50	0.50	10.00	4.25	0.25	0	0	0	36.00
1850-51	0	0	0	0	.65	.35	1.88	1.14	.69	0	0	0	4.71
1851-52	1.00	.18	2.14	7.07	.58	.12	6.40	.19	.30	0	0	0	17.98
1852-53	0	0	6.00	13.41	3.00	2.00	7.00	3.50	1.45	0	0	0	36.36
1853-54	0	.01	1.50	1.54	3.25	8.50	3.25	1.50	.21	0.31	0	0	20.07
1854-55	0	1.01	.65	1.15	2.67	3.46	4.20	4.32	1.15	.01	0	0	18.62
1855-56	0	0	.75	2.00	4.92	.69	1.40	2.13	1.84	.03	0	0	13.76
1856-57	0	.20	.65	2.40	1.38	4.86	.67	0	0	.35	0.01	0	10.46
1857-58	0	.66	2.41	6.63	2.44	2.46	2.88	1.21	.20	.10	0	0	18.99
1858-59	0	3.01	.15	4.34	.96	3.91	1.64	.98	1.04	0	.03	0	16.06
1859-60	.02	0	6.48	1.83	2.31	.93	5.11	2.87	2.49	.02	.55	0	22.61
1860-61	.06	.91	.18	4.28	2.67	2.92	3.32	.48	.59	.13	0	0	15.54
1861-62	0	0	2.17	8.64	15.04	4.26	2.80	.82	1.81	.01	0	0.01	35.56
1862-63	0	.36	0	2.33	1.73	2.75	2.36	1.69	.35	0	0	0	11.57
1863-64	0	0	1.49	1.82	1.08	.19	1.30	1.08	.74	.09	0	.08	7.87
1864-65	0	.12	6.72	7.87	4.78	.71	.48	1.37	.46	0	0	0	22.51
1865-66	.08	.48	2.43	.36	7.70	2.01	2.02	.48	2.25	.10	.02	0	17.93
1866-67	0	0	2.43	9.51	3.44	7.10	1.01	1.80	.01	0	0	0	25.30
1867-68	.01	0	3.81	12.85	6.04	3.15	4.35	2.31	.27	T.	0	0	32.79
1868-69	0	0	.77	2.61	4.79	3.63	2.94	1.24	.65	.01	0	0	16.64
1869-70	T.	2.12	.85	1.96	1.37	3.24	1.64	2.12	.27	T.	T.	0	13.57
1870-71	0	.02	.58	.97	2.08	1.92	.69	1.45	.76	T.	0	0	8.47
1871-72	T	.21	1.22	10.59	4.04	4.74	1.94	.61	.28	.02	0	0	23.65
1872-73	T.	.22	1.93	5.39	1.23	4.36	.55	.51	0	T.	.02	T.	14.21
1873-74	0	.31	1.21	10.01	5.20	1.86	3.05	.89	.37	T.	T.	0	22.90
1874-75	.05	2.26	3.80	.44	8.70	.55	.80	T.	T.	1.10	0	0	17.70
1875-76	0	.44	6.20	5.52	4.99	3.75	4.15	1.10	.15	0	.21	.02	26.53
1876-77	T.	3.45	.30	0	2.77	1.04	.56	.19	.64	.01	T.	T.	8.96
1877-78	0	.73	1.07	1.43	9.26	8.04	3.09	1.07	.17	0	0	0	24.86
1878-79	.29	.55	.51	.47	3.18	3.88	4.88	2.66	1.30	.13	T.	T.	17.85
1879-80	0	.88	2.05	3.41	1.64	1.83	1.70	14.20	.76	0	T.	0	26.47
1880-81	0	0	.05	11.81	6.14	5.06	1.37	1.64	T.	.50	T.	0	26.57
1881-82	.30	.55	1.88	3.27	1.89	2.40	3.78	1.99	.35	.10	T.	0	16.51
1882-83	.57	2.63	3.22	1.13	2.23	1.11	3.70	.67	2.85	0	0	0	18.11
1883-84	.90	.97	.61	.44	3.43	4.46	8.14	4.32	.06	1.45	0	T.	24.78
1884-85	.60	2.01	0	10.45	2.16	.49	.08	.68	T.	.11	T.	0	16.58
1885-86	.08	.02	11.34	5.76	7.95	.29	2.68	4.08	.07	0	0	0	32.27
1886-87	0	.68	.21	2.21	1.12	6.28	.94	2.53	T.	0	0	T.	13.97
1887-88	.02	0	.45	2.09	4.81	.57	3.04	.10	.40	.08	T.	T.	11.56
1888-89	.55	0	4.28	4.63	.15	.33	6.25	.26	3.25	.25	0	0	19.95
1889-90	0	6.02	3.15	7.82	6.62	4.06	3.00	1.33	1.80	0	0	T.	33.80
1890-91	.80	T.	0	3.34	.53	6.61	1.78	2.04	.66	.05	T.	0	15.81
1891-92	.10	.10	.48	3.28	1.78	2.84	3.02	1.20	2.38	T.	0	0	15.18
1892-93	.18	.70	6.60	4.90	3.27	2.66	3.51	1.08	1.05	0	T.	T.	23.95
1893-94	.22	.12	2.92	1.76	4.17	3.92	.74	.34	1.70	.46	T.	T.	16.35
1894-95	.88	1.06	.48	8.86	8.42	1.84	1.20	.86	.51	0	.04	T.	24.15
1895-96	1.26	.17	1.54	1.54	9.76	.09	2.57	5.34	.92	0	T.	.20	23.39
1896-97	.31	.55	3.56	1.76	3.66	4.15	2.54	.25	.30	.04	0	.01	17.13
1897-98	.16	1.96	.61	1.64	.98	3.19	.04	.28	1.50	.14	0	0	10.50
1898-99	.36	.64	.61	2.30	3.94	.04	6.02	.10	.54	.49	0	.02	15.06
1899-1900	0	4.46	2.62	2.91	3.54	.32	1.61	1.88	2.88	T.	T.	0	20.22
1900-1901	0	1.74	4.50	1.38	3.70	5.32	.48	2.23	.80	T.	T.	T.	20.15
1901-2	.56	1.56	2.68	1.19	.95	6.52	1.99	1.36	.45	.01	0	T.	17.27
53 years mean													19.62

Record of precipitation at Barstow, San Bernardino County.

[Latitude, 34° 51′; longitude, 116° 59′; elevation, 2,150 feet. Authority, W. L. Burbeck, Geo. R. Gooding, G. W. Fetts, and others.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888–89	------	------	------	------	0.14	0.04	0.93	0	0.12	0	0	0.13	[a] 1.36
1889–90	0.07	0.23	0.70	3.87	.36	.15	T.	.07	0	0	0	.15	5.60
1890–91	.59	0	.05	.52	0	2.47	T.	.05	T.	0	T.	.06	3.74
1891–92	.08	0	T.	.25	------	------	------	------	------	------	------	------	[a] .33
1892–93	------	------	------	------	.11	.27	.77	.06	T.	0	1.10	0	[a] 2.31
1893–94	0	.22	T.	.72	.02	.21	.06	0	.22	T.	T.	0	1.45
1894–95	0	0	0	.92	1.06	0	.20	0	0	0	0	0	2.18
1895–96	0	.33	T.	0	.16	0	.08	0	0	0	.07	.87	1.51
1896–97	0	1.55	.25	.30	2.15	.65	.11	0	0	T.	0	.18	5.19
6-year mean	------	------	------	------	------	------	------	------	------	------	------	------	3.28
1901–2	------	------	------	------	------	------	0	0	0	0	0	0	[a] 0

[a] Year incomplete.

Record of precipitation at Deep Creek, San Bernardino County.

[Latitude, 34° 15′; longitude, 17° .07′; elevation, 5,200 feet. Authority, Arrowhead Reservoir Company.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893–94	1.95	1.19	1.20	4.16	1.94	1.89	2.75	0.70	1.01	0.12	0.09	0.80	17.80
1894–95	.49	.30	0	18.41	13.14	2.13	7.21	1.36	0	0	0	0	43.04
1895–96	0	0	2.45	1.09	1.86	.05	3.52	1.75	.28	0	0	.78	11.78
1896–97	0	2.28	1.65	2.41	5.43	13.03	7.59	0	.19	.10	0	0	32.68
1897–98	.28	3.92	1.17	1.40	4.20	1.10	1.89	.17	2.93	.05	.11	.55	17.77
1898–99	0	0	.53	.49	------	------	------	------	------	------	------	------	[a] 1.02
1899–1900	------	------	------	------	1.40	.28	3.07	2.70	4.75	------	------	------	[a] 12.20
5-year mean	------	------	------	------	------	------	------	------	------	------	------	------	24.61

[a] Year incomplete.

Record of precipitation at Bear Valley dam, San Bernardino County.

[Latitude, 34° 15′; longitude, 116° 58′; elevation, 6,500 feet.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1883–84	------	------	------	------	------	------	------	------	------	------	------	------	94.60
1884–85	------	------	------	------	------	------	------	------	------	------	------	------	28.06
1885–86	------	------	------	------	------	------	------	------	------	------	------	------	65.51
1886–87	------	------	------	------	------	------	------	------	------	------	------	------	24.00
1887–88	------	------	------	------	------	------	------	------	------	------	------	------	62.30
1888–89	------	------	------	------	------	------	------	------	------	------	------	------	46.03
1889–90	------	------	------	------	------	------	------	------	------	------	------	------	93.40
1890–91	------	------	------	------	------	------	------	------	------	------	------	------	78.40
1891–92	------	------	------	------	------	------	------	------	------	------	------	------	38.00
1892–93	------	------	------	------	------	------	------	------	------	------	------	------	44.32
10-year mean	------	------	------	------	------	------	------	------	------	------	------	------	57.46

Record of precipitation at Glen Ranch, San Bernardino County.

[Latitude, 34° 50′; longitude, 117° 30′; elevation, 3,112 feet. Authority, Jas. M. Applewhite, Cajon.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Total.
1899-1900	0.10	0.03	0.96	1.90	2.15	0.10	3.84	1.35	1.69	0.02	0.01	0	11.25
1900-1901	.31	.46	9.39	0	6.53	9.78	.43	1.40	.96	0	0	0	29.26
1901-2	0	2.61	.58	.10	1.73	3.67	5.54	.53	0	.24	0	0	15.00
3-year mean													18.50

Record of precipitation at Holcomb Creek, San Bernardino County.

[Latitude, 34° 17′; longitude, 117° 05′; elevation, 5,220 feet. Authority, Arrowhead Reservoir Company.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1894-95					10.06	0.61	4.86	0.62	0	0	0	0	[a] 16.15
1895-96	0	0	1.66	0.41	1.56	T.	3.24	1.02	0.25	0	0	0.47	8.61
1896-97	0	1.70	1.05	1.82	3.35	7.89	3.42	0	.11	0.20	0	0	19.54
1897-98	0.38	3.32	1.09	.90	3.05	.52	1.27	.10	1.46	0	0	.66	12.75
1898-99	0	0	.57	.48									[a] 1.05
1899-1900					.38	.21	1.14	1.25	1.20				[a] 4.18
7-year mean													13.63

[a] Year incomplete.

Record of precipitation at Little Bear Valley, San Bernardino County.

[Latitude, 34° 15′; longitude, 117° 13′; elevation, 5,150 feet. Authority, Arrowhead Reservoir Company.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893-94	1.21	1.49	2.55	7.61	2.48	2.25	3.16	0.62	1.34	0.12	0.04	0.31	23.18
1894-95	.52	.38	0	20.12									[a] 21.02
1896-97													
1897-98					3.80	1.38	2.49	.25	4.56		0		[a] 12.48
1898-99		T.	.62	.74									[a] 1.36
1899-1900					1.59	.43	3.42	3.11	4.63				[a] 12.98

[a] Year incomplete.

Record of precipitation at Mill Creek "A," San Bernardino County.

[Latitude, 34° 05′; longitude, 116° 54′; elevation, 5,000 feet. Authority, Redlands Electric Light and Power Company.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1899-1900					2.52	0.43	2.28	4.49					[a] 9.72
1900-1901			9.05		4.32	6.00	.71	.39	1.85	0	0	1.20	[a] 23.52
1901-2	0	.95	.82	0									[a] 2.77

[a] Year incomplete.

Record of precipitation at Mill Creek "B," San Bernardino County.

[Latitude, 34° 04′; longitude, 116° 58′; elevation, 2,915 feet. Authority, Redlands Electric Light and Power Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1899-1900	.....	.....	.....	.....	1.41	0.07	1.43	3.74	3.31	0	0	0	[a]9.96
1900-1901	1.14	1.15	4.96	0	.....	.....	.....	.....	.....	.....	.....	.....	[a]7.25

[a] Year incomplete.

Record of precipitation at Morse's house, San Bernardino County.

[Latitude, 34° 12′; longitude, 117° 12′; elevation, 5,350 feet. Authority, Arrowhead Reservoir Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893-94	0.25	2.44	2.75	14.73	4.78	3.93	5.00	1.37	2.08	0.60	0.02	0.74	38.69
1894-95	.67	.47	0	26.77	18.00	5.85	12.54	2.91	0	0	0	0	67.21
1895-96	0	0	4.18	3.11	5.95	.08	7.90	2.63	.89	0	0	.46	25.20
1896-97	0	3.83	1.96	2.73	9.34	20.14	15.61	.15	.18	.40	0	0	54.34
1897-98	.73	5.08	1.93	1.85	6.37	2.96	4.22	.70	8.27	.25	.08	.30	32.74
1898-99	.....	.34	.74	1.28	.....	.....	.....	.....	.....	.....	.....	.....	[a]2.36
1899-1900	.....	.....	.....	.....	2.20	.44	3.83	5.81	8.64	.....	.....	.....	[a]20.92
5-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43.64

[a] Year incomplete.

Record of precipitation at Rancho del Jurupa, San Bernardino County.

[Latitude, 34° 02′; longitude, 117° 27′; elevation, 1,000 feet. Authority, United States post hospital.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1882-83	0	0	2.89	7.50	0.25	0.67	3.15	0.33	1.14	0	0	0.18	16.11
1883-84	0	0	.44	2.04	1.64	2.34	3.09	.....	.....	.....	.....	.....	[a]9.55

[a] Year incomplete.

Record of precipitation at Redlands, San Bernardino County.

[Latitude, 34° 03′; longitude, 117° 10′; elevation, 1,335 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Apr.	May.	June.	July.	Aug.	Total.
1888-89	0	0.05	4.12	4.64	0.68	1.47	5.70	0.99	0.58	0	0	0.28	18.51
1889-90	0.31	1.50	.52	13.72	4.69	3.03	.89	.16	.68	0	0	2.16	27.66
1890-91	.88	29	0	3.02	0	9.28	1.19	.91	1.10	0.23	0	1.63	18.53
1891-92	.97	0	0	1.51	.87	4.37	2.06	.13	0	0	0	0	9.91
1892-93	.03	0	.46	1.14	2.39	2.65	6.26	.05	0	0	.03	0	13.01
1893-94	.18	1.00	.05	2.59	.67	.90	.59	.31	.62	0	0	.11	7.02
1894-95	.10	.08	0	4.35	6.54	1.12	2 74	0	.45	0	0	0	15.38
1895-96	0	.03	1.17	.33	1.29	.06	2.47	.43	.85	0	0	1.03	7.66
1896-97	0	1.72	2.07	.16	4.33	3.89	1.92	.10	.19	0	0	0	14.38
1897-98	.83	1 92	.07	.51	2.56	.60	.84	.18	1.59	0	0	T.	9.10
1898-99	.01	.01	.25	.40	1.92	.71	1.50	.08	.24	.87	0	.04	6.03
1899-1900	.05	.65	1.28	.46	1.20	T	.78	2.03	1.41	0	.04	0	7.90
1900-1901	.50	.53	3.88	0	2.25	3.79	.46	T.	1.62	.04	0	0	13.07
1901-2	0	.92	.09	T.	1.64	2.58	2.82	.36	.08	.31	.07	0	8.87
14-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.64

Record of precipitation at Rings Station, San Bernardino County.

[Latitude, 34° 02′; longitude, 116° 46′; elevation, 4,300 feet. Authority, John J. Ring.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1874-75	0.09	0.61	2.55	0.78	5.64	2.08	0.58	0.37	0	0	0	0	12.70
1875-76	.43	T.	4.06	.25	9.31	5.54	6.23	.99	0.20	0	0.03	0	27.04
1876-77	.19	.18	0	0	5.75	2.33	3.93	2.59	3.93	0	.30	0	19.20
1877-78	0	1.30	0.80	4.03	6.03	10.49	4.41	6.86	1.33	0.26	.03	0.20	35.74
1878-79	0	0	.97	1.52	2.88	5.11	.55	3.23	0	0	0	0	14.26
1879-80	0	1.00	4.10	9.39	1.78	2.81	3.04	1.39	.14	0	0	.09	23.74
1880-81	0	.50	1.05	10.27	2.48	1.86	3.39	2.93	.35	0	.94	0	23.77
1881-82	0	1.30	.08	.42	3.30	7.29	5.38	4.21	.35	1.30	0	0	23.63
8-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22.51

Record of precipitation at Santa Ana Canyon, San Bernardino County.

[Latitude, 34° 09′; longitude, 117° 07′; elevation, 3,000 feet. Authority, Edison Electric Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1899-1900	.....	.....	.....	.....	.....	.....	0.74	5.87	.....	.....	.....	.....	[a]6.61
1900-1901	.....	.....	.....	.....	5.53	7.82	1.10	1.38	1.36	.....	.....	.....	[a]17.19

[a] Year incomplete.

Record of precipitation at Squirrel Inn, San Bernardino County.

[Latitude, 34° 12′; longitude, 117° 15′; elevation, 5,300 feet. Authority, Arrowhead Reservoir Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893-94	0.38	1.90	5.00	8.93	4.00	3.23	3.54	1.17	1.37	0.23	0	0.62	30.37
1894-95	.50	.34	0	16.38	14.22	5.35	9.58	2.53	0	0	0	0	48.90
1895-96	0	0	2.92	1.98	4.51	0	5.60	.98	.89	0	0	.38	17.26
1896-97	0	3.20	1.60	2.23	7.65	13.31	12.17	.13	3.03	.20	0	0	43.52
1897-98	0	0	.....	.....	4.98	1.95	2.98	.68	6.50	.....	0	.....	[a]17.09
1898-99	.05	.37	.70	1.35	.....	.....	.....	.....	.....	.....	.....	.....	[a]2.47
1899-1900	.....	.....	.....	.....	1.73	.26	3.04	4.81	6.37	.....	.....	.....	[a]16.21
4-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35.01

[a] Year incomplete.

Record of precipitation at Upper Holcomb Valley, San Bernardino County.

[Latitude, 34° 18′; longitude, 116° 55′; elevation, 7,200 feet. Authority, Arrowhead Reservoir Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1897-98	.....	.....	.....	.....	2.60	0.40	1.50	0.50	.....	.....	.....	.....	[a]5.00

[a] Year incomplete.

Record of precipitation at Campo, San Diego County.

[Latitude, 32° 37′; longitude, 116° 30′; elevation, 2,660 feet. Authority, A. Campbell, Campo.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1876–77	.....	.....	.....	.....	.....	.....	2.29	1.08	0.91	0	0.50	0	[a] 4.78
1877–78	0	0.35	1.50	2.44	1.79	5.45	1.84	5.75	.41	0	2.32	0.01	21.86
1878–79	0	.31	.55	1.29	2.18	1.32	.60	2.01	0	0	0	0	8.26
1879–80	0	0	3.00	2.23	3.00	2.15	3.56	4.00	0	0	.12	.41	18.47
1880–81	0.01	.68	.85	4.85	1.74	.53	5.00	1.52	.12	0.04	.07	1.27	16.68
1881–82	.02	.73	.11	.24	3.10	4.57	1.01	1.10	.18	.26	.62	.53	12.47
1882–83	.02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	[a] .02
1888–89	.....	.....	.....	.....	.....	4.65	4.00	.....	.45	.10	.....	2.50	[a] 11.70
1889–90	.50	1.10	1.67	9.34	2.40	7.25	1.69	1.86	.90	.16	2.26	2.67	31.80
1890–91	1.80	.44	.95	2.80	0	13.30	.50	1.20	.75	0	0	[b] 16.10	37.84
1891–92	0	0	.25	3.21	.75	4.55	3.30	1.25	2.75	.35	0	0	16.41
1892–93	0	.12	.71	.50	3.55	3.65	7.19	1.54	.41	0	0	0	17.67
1893–94	.57	.11	3.38	2.08	5.89	5.83	1.01	.80	4.38	1.26	0	0	25.31
1899–1900	.24	.60	1.61	1.15	2.65	.10	.55	2.07	1.04	.10	0	0	10.11
1900–1901	.05	.28	4.47	0	2.03	8.22	.69	.54	1.18	0	.61	.63	18.70
1901–2	0	1.02	.43	.23	4.28	4.72	4.00	1.33	.07	.12	2.24	0	18.44
13-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.54

[a] Year incomplete. [b] Cloudburst; rain gage washed away. Record incomplete.

Record of precipitation at Cuyamaca Reservoir, San Diego County.

[Latitude, 33° 00′; longitude, 116° 40′; elevation, 4,800 feet. Authority, San Diego Flume Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1887–88	0	0.78	3.64	6.00	3.35	3.12	4.12	0.21	0	0	0.93	0.04	22.19
1888–89	0.21	3.82	8.33	13.30	2.99	4.70	12.85	3.44	2.22	0	0	1.71	53.57
1889–90	.03	3.82	1.64	20.96	8.05	16.36	4.00	1.02	3.92	0	.09	.90	60.79
1890–91	1.45	.58	3.62	12.14	0	34.70	3.17	3.50	3.69	0	.04	.30	63.19
1891–92	.69	0	.45	6.75	7.23	6.47	7.76	3.35	5.90	0.67	0	0	39.27
1892–93	0	.30	2.87	3.76	5.55	9.13	15.60	1.00	1.00	0	1.20	.30	40.71
1893–94	0	1.90	3.30	2.75	2.05	2.05	0	0	1.00	.50	0	.50	14.05
1894–95	.30	0	0	12.80	28.43	4.60	5.89	1.10	1.16	0	0	0	54.28
1895–96	3.00	1.03	6.01	1.66	5.77	.20	3.01	1.78	.92	0	1.29	.87	25.54
1896–97	1.06	4.93	3.45	3.74	6.32	8.14	8.56	.22	.38	0	0	0	36.80
1897–98	.36	5.09	1.07	2.46	5.47	1.97	4.06	1.24	5.97	0	0	1.32	29.01
1898–99	0	0	.88	.96	7.02	1.53	7.23	.98	.47	2.96	.04	T.	22.07
1899–1900	0	4.51	3.45	2.49	3.62	.26	2.51	6.69	2.81	.10	.28	0	26.72
1900–1901	.92	.74	11.97	.04	8.17	13.26	2.32	1.24	3.87	0	T.	.09	42.62
1901–2	.08	1.94	1.48	.52	8.17	5.70	13.82	2.09	.14	.17	1.54	0	35.65
15-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37.76

Record of precipitation at Descanso, San Diego County.

[Latitude, 32° 50′; longitude, 116° 40′; elevation, 3,500 feet. Authority, E. W. Hulburd, Descanso.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895–96	T.	0.38	4.37	1.00	2.93	0.10	8.04	1.14	0.17	0	0.30	1.38	19.81
1896–97	0.03	2.71	2.12	2.43	6.48	6.27	5.21	.16	.21	0.01	.62	.04	26.29
1897–98	.56	2.83	.40	2.90	5.28	.89	4.11	.90	2.35	0	.15	.83	21.20
1898–99	0	0	.35	1.00	3.49	1.69	2.73	.25	1.45	0	.15	.38	11.49
1899–1900	0	1.62	.25	1.06	4.00	.75	1.25	4.25	2.69	.06	0	T.	15.93
1900–1901	.25	.63	6.50	.15	3.25	11.00	1.40	.57	1.53	0	T.	.78	26.06
1901–2	T.	1.25	.87	.12	4.47	4.52	8.00	1.50	.06	0	.45	0	21.24
7-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20.29

Record of precipitation at Julian, San Diego County.

[Latitude, 33° 04′; longitude, 116° 36′; elevation, 4,500 feet. Authorities, J. S. Beck and Mrs. S. L. Harritt.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1879-80	0	0	2.13	4.50	1.50	5.75	9.25	7.50	0	0	0	0	30.63
1880-81	0	0	2.25	2.75	5.13	4.88	8.13	2.75	0	0	0	0	25.89
1881-82	0	0	1.88	6.88	5.13	3.38	7.13	4.88	0	0	0	0	29.28
1882-83	0	0	5.13	6.25	10.04	6.63	9.13	4.13	0	0	0	0	41.31
1883-84	0	2.75	0	6.00	2.25	20.63	15.63	10.63	3.63	0	0	0	61.52
1889-90	.....	.....	.....	.....	6.12	10.39	3.63	1.11	2.54	0	0	1.25	a 25.04
1890-91	1.25	0	2.00	6.36	.07	19.32	2.09	2.66	3.00	0	0	.89	37.64
1891-92	.81	0	2.25	8.61	6.17	6.69	1.54	6.11	3.55	0.41	0	.11	36.25
1892-93	0	.56	1.53	2.81	3.76	3.72	14.42	.66	.62	0	1.65	.41	30.14
1893-94	.03	2.20	3.25	4.00	4.40	2.77	4.19	.32	.68	.04	.17	.34	22.39
1894-95	.21	T.	0	9.38	16.32	3.80	5.04	.95	.45	T.	T.	.70	36.85
1895-96	0	.70	2.60	.75	4.55	.40	6.10	1.40	.10	0	.17	.34	17.11
11 year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33.55

a Year incomplete.

Record of precipitation at Laguna, San Diego County.

[Latitude, 32° 50′; longitude, 116° 31′; elevation, 5,440 feet. Authority, Arch. Campbell, Campo.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1884-85	.....	.....	.....	.....	.....	.....	.....	2.10	1.36	0.17	0	1.87	a 5.50
1885-86	.....	0.44	2.71	0.60	.....	.....	.....	.....	.....	0	0.21	2.43	a 6.39
1886-87	0	.29	1.40	0	.....	.....	.....	.....	.....	.....	.....	.....	a 1.69
1890-91	.....	.....	.....	.....	.....	.....	.....	.....	.60	0	1.15	2.83	a 4.58
1894-95	.....	.....	.....	9.97	17.44	2.87	2.70	0	.45	0	0	0	a 33.43
1895-96	0	.....	6.40	.....	3.55	.....	5.60	1.55	.25	0	1.50	3.83	22.68
1896-97	0	3.35	2.48	2.74	3.60	1.08	.....	.....	.....	.....	.....	.....	a 13.25
1897-98	0.03	2.50	0	1.80	.....	8.10	.....	4.44	.....	0	0	0	16.87
1898-99	0	0	.....	.....	.....	16.00	.....	.....	0	0	0	0	a 16.00
1899-1900	0	1.85	2.70	1.65	3.30	.37	1.00	3.80	2.19	.30	0	0	17.16
1900-1901	.20	.40	6.20	0	5.60	8.60	.95	.71	2.09	0	.42	1.25	26.42
1901-2	0	1.42	.54	.35	.40	.35	6.15	1.05	.11	.21	2.32	.48	13.38
9-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.30

a Year incomplete.

Record of precipitation at Nellie, San Diego County.

[Latitude, 33° 20′; longitude, 116° 55′; elevation, 5,240 feet. Authority, N. A. Clark.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1901-2	.....	2.55	1.75	0.55	17.60	7.34	10.21	2.20	0.25	0	0.06	0	a 42.51

a Year incomplete.

Record of precipitation at San Diego, San Diego County.

[Latitude, 32° 45′; longitude, 117° 8′; elevation, 69 feet. Authorities, U. S. War Department and Weather Bureau.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1849-50	.....	.....	.....	.....	0	1.13	1.00	0.09	0	0.68	0	0	[a]2.90
1850-51	0	0.19	2.82	1.93	0.03	1.51	.34	.87	0.71	.01	0	0	8.41
1851-52	0.02	.01	.25	3.74	.58	1.84	1.87	.85	.32	0	0	0.40	9.88
1852-53	0	.06	1.45	4.50	.50	.20	1.52	.25	2.10	.05	0	.21	10.84
1853-54	0	0	1.28	1.77	.99	2.56	1.88	.89	.18	.01	0.07	1.36	10.99
1854-55	.09	.27	.04	3.29	1.97	3.59	1.30	1.52	.06	0	0	.04	12.17
1855-56	0	.11	2.15	.41	1.27	1.86	1.59	2.17	.29	0	0	0	9.85
1856-57	.07	0	1.22	1.30	.26	1.76	0	.04	.08	.03	0	.02	4.78
1857-58	.01	.49	2.16	1.30	1.52	.44	1.24	.17	0	.19	0	.04	7.56
1858-59	.10	.47	.28	3.10	0	1.89	.20	.36	.17	0	.02	0	6.59
1859-60	0	.18	1.49	1.79	.72	1.49	.15	.65	.04	.05	.14	0	6.70
1860-61	0	0	2.88	2.99	.82	.79	.05	.04	0	.19	0	0	7.76
1861-62	1.59	.05	1.19	3.20	5.56	1.39	.97	1.05	.16	.48	.11	0	15.75
1862-63	0	.89	.05	.93	.32	1.09	.33	.13	.02	0	0	0	3.76
1863-64	.36	0	.73	.04	.04	2.50	.20	.01	1.25	.01	.11	0	5.25
1864-65	0	.04	2.41	1.04	1.28	3.00	0	.56	0	.01	1.29	0	9.63
1865-66	0	.02	.52	.84	5.05	3.43	1.47	.11	.09	0	0	.10	11.63
1866-67	0	0	.24	1.82	2.32	.85	7.88	.48	.04	0	0	.30	13.93
1867-68	0	.34	.45	3.06	3.37	1.63	.73	1.20	.15	0	.51	0	11.44
1868-69	.05	0	2.00	1.52	2.88	1.88	1.98	.53	.33	0	.05	0	11.22
1869-70	0	.05	2.32	.94	.54	.77	.33	.20	.28	0	.04	.07	5.54
1870-71	0	1.54	.18	.42	.52	1.35	.01	.70	.34	0	0	0	5.06
1871-72	0	0	1.33	1.39	.99	2.63	.46	.26	.12	0	0	.18	7.36
1872-73	0	0	0	1.40	.44	4.15	.11	.10	.03	0	0	1.95	8.18
1873-74	0	0	.77	5.46	3.11	3.73	1.20	.34	.34	0	.12	0	15.07
1874-75	.11	.53	.88	.55	2.38	.37	.45	.12	.20	.02	0	.21	5.82
1875-76	.39	0	2.25	.41	2.47	2.44	1.78	.06	.05	.05	.03	.06	9.99
1876-77	.03	.08	.04	.15	1.05	.18	1.44	.26	.43	0	0	0	3.66
1877-78	0	.81	.06	3.89	1.45	4.83	1.41	2.91	.58	.16	0	0	16.10
1878-79	0	.96	0	1.57	3.54	1.04	.10	.60	T.	.07	0	0	7.88
1879-80	0	.29	2.77	6.30	.61	1.50	1.43	1.34	.06	.06	.09	.32	14.77
1880-81	0	.53	.28	4.15	.52	.45	1.88	1.35	.04	.05	0	.01	9.26
1881-82	.04	.24	.12	.30	4.53	2.55	1.02	.45	.18	.07	0	T.	9.50
1882-83	.01	.41	.39	.13	1.09	.95	.41	.31	1.14	.08	0	0	4.92
1883-84	0	2.01	.20	1.82	1.34	9.05	6.23	2.84	2.17	.31	0	T.	25.97
1884-85	.07	.35	.11	5.12	.35	.02	.78	1.20	.61	.06	T.	.13	8.80
1885-86	T.	.31	1.56	.71	6.95	1.51	3.73	1.95	.04	.07	T.	T.	16.83
1886-87	0	.05	.95	.10	.04	4.51	.02	2.14	.47	.04	.01	T.	8.33
1887-88	T.	T.	2.08	1.14	1.96	1.48	2.79	.10	.22	.04	.01	T.	9.82
1888-89	.04	.26	1.83	2.84	1.72	1.80	2.20	.19	.03	.10	T.	.04	11.05
1889-90	T.	2.12	.12	7.71	2.79	1.70	.41	.05	.08	0	0	0	14.98
1890-91	.65	.01	.72	1.61	1.21	4.84	.27	.76	.35	.05	T.	0	10.47
1891-92	.08	.04	.10	1.29	1.58	2.96	.96	.41	1.15	.13	0	.05	8.75
1892-93	T.	.22	.94	.69	.78	.47	5.50	.22	.39	T.	T.	0	9.21
1893-94	0	.11	.91	1.91	.29	.49	1.05	.11	.09	.01	0	.04	5.01
1894-95	.01	T.	0	2.26	7.33	.53	1.43	.11	.19	0	0	0	11.86
1895-96	.01	.27	1.19	.27	1.27	.02	2.89	.25	.03	.01	T.	.13	6.34
1896-97	T.	.97	.98	2.18	3.13	2.72	1.58	.02	.12	T.	.01	T.	11.71
1897-98	T.	1.06	.02	.32	1.71	.06	.91	.22	.66	.02	0	0	4.98
1898-99	.07	0	.15	.87	2.34	.30	.85	.29	.10	.27	0	07	5.31
1899-1900	0	.35	.86	.65	.69	.03	.53	1.26	1.45	.08	0	T.	5.90
1900-1901	T.	.30	1.43	0	2.08	4.77	1.07	.01	.77	.02	T.	T.	10.45
1901-2	.06	.28	.41	.02	1.70	1.57	1.86	.21	.06	T.	.92	T.	7.09
52-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.50

[a] Year incomplete.

Record of precipitation at Warners, San Diego County.

[Latitude, 33° 5′; longitude, 116° 40′; elevation, 2,894 feet. Authority, Charles E. McGary.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900-1901	.....	.....	1.93	.....	2.58	5.98	0.35	0.20	0.97	.....	.....	.....	[a] 12.01

[a] Year incomplete.

Record of precipitation at Santa Barbara, Santa Barbara County.

[Latitude, 34° 25′; longitude, 119° 40′; elevation, 100 feet. Authority, United States War Department and Weather Bureau.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1867-68	0	0	2.31	12.67	3.97	2.00	1.08	2.44	.72	0	0	0	25.19
1868-69	0	0	1.25	4.26	3.26	2.12	4.22	.46	.20	0	0	0	15.77
1869-70	0	0.30	.65	.57	.25	5.87	.83	.99	.74	0.07	0	0	10.27
1870-71	0	1.04	.27	1.41	.86	2.92	.02	2.02	.37	0	0	0	8.91
1871-72	0	.09	1.83	6.56	2.53	1.81	.18	1.80	0	.14	0	0.02	14.96
1872-73	0.05	0	0	4.34	.58	5.48	.05	0	0	0	0	0	10.50
1873-74	0	0	.27	5.26	4.54	3.17	.78	.28	.14	0	0	0	14.44
1874-75	0	1.91	1.30	0	14.84	.18	.38	.10	0	0	0	0	18.71
1875-76	0	0	6.53	.31	7.56	5.67	2.73	.27	0	0	0	0	23.07
1876-77	0	.32	0	0	2.72	0	.82	.18	.45	0	0	0	4.49
1877-78	0	0	1.32	3.12	7.17	11.73	2.47	3.34	.29	.07	0	0	29.51
1878-79	0	.32	0	5.16	5.24	.71	.34	1.60	.21	0	0	0	13.58
1879-80	0	.41	1.62	4.57	1.30	10.86	1.15	5.73	0	0	0	0	25.64
1880-81	0	.25	.28	9.73	2.83	.30	1.25	.59	0	0	0	0	15.23
1881-82	.44	1.47	.33	.95	1.13	2.38	5.74	1.63	0	.20	0	0	14.27
1882-83	0	.37	.77	.10	2.18	2.92	3.64	.29	2.79	.35	0	0	13.41
1883-84	0	1.32	0	2.76	6.33	9.68	9.77	2.60	.39	1.62	0	0	34.47
1884-85	0	1.02	.79	6.62	1.23	.07	.35	3.00	0	0	0	0	13.08
1885-86	0	.19	9.84	2.47	5.12	1.19	2.03	3.40	0	0	0	0	24.24
1886-87	0	.39	.87	.86	.31	8.64	.13	1.43	.33	.03	0	0	12.99
1887-88	.38	.31	1.10	4.43	10.15	1.30	3.86	.16	.02	T.	T.	T.	21.71
1888-89	.03	.07	5.62	5.59	.29	1.29	7.31	.49	.76	.13	0	0	21.58
1889-90	0	8.65	3.21	10.64	5.32	2.96	1.10	.31	.18	0	0	0	32.37
1890-91	1.50	0	.48	3.53	.50	8.82	1.65	1.90	0	0	0	0	18.38
1891-92	.18	0	0	2.26	1.04	2.48	3.36	.34	.62	0	0	0	10.28
1892-93	0	.42	3.70	7.31	4.52	3.55	7.53	.38	0	0	0	0	27.41
1893-94	0	.62	T.	3.50	.65	.50	.22	.35	.86	0	.15	0	6.85
1894-95	1.36	.78	.11	4.16	6.25	.67	1.99	.46	.02	.05	T.	0	15.85
1895-96	.6	.55	.77	.93	6.84	0	2.37	1.78	.08	.05	.40	0	13.77
1896-97	0	.92	3.51	2.92	4.35	3.65	2.73	.02	0	0	0	0	18.10
1897-98	0	1.44	0	0	.63	1.39	.28	T.	1.25	0	T.	0	4.99
1898-99	3.17	.14	0	.36	4.48	0	2.78	.64	0	.78	0	0	12.35
1899-1900	0	2.06	1.97	2.35	2.32	.05	1.58	.42	1.90	.01	.02	T.	12.68
1900-1901	.04	.15	3.99	.02	4.86	3.65	.16	2.07	.34	.10	.06	.09	15.53
1901-2	.36	2.42	1.16	T.	1.36	4.40	2.89	1.40	.07	0	0	0	14.06
Average	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.82

Record of precipitation at Mount Hamilton (Lick Observatory), Santa Clara County.

[Latitude, 37° 20′; longitude, 121° 38′; elevation, 4,440 feet. Authority, Lick Observatory.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1880–81	.....	.....	.....	.....	3.11	5.99	1.13	0.98	0.09	0.33	0	0	[a]11.63
1881–82	0.10	0.33	0.91	9.72	3.55	2.90	5.40	4.70	.48	1.06	0	0	29.15
1882–83	0	6.16	3.45	1.93	3.10	3.75	8.66	2.66	7.56	0	0	0	37.27
1883–84	.65	2.60	1.48	2.05	5.60	12.76	16.35	11.96	1.24	3.85	0	0.15	58.69
1884–85	.65	3.71	.01	33.84	1.99	.57	1.15	2.08	.16	.36	0	0	44.52
1885–86	.15	.05	3.01	6.76	4.53	1.80	5.77	6.79	.70	0	0	0	29.56
1886–87	0	.60	2.82	2.34	2.83	7.80	1.39	5.75	.25	.30	0.04	0	24.12
1887–88	.33	.09	.90	11.25	10.04	1.38	3.40	.68	1.25	0	0	.02	29.34
1888–89	.49	.03	3.27	4.23	1.04	1.42	6.17	1.92	3.21	.05	0	0	21.83
1889–90	0	4.38	4.69	13.19	7.92	2.04	4.39	1.79	2.42	0	0	0	40.82
1890–91	.80	.02	.58	5.39	1.38	6.52	4.26	3.08	1.12	.57	0	0	23.72
1891–92	.28	.61	.38	9.54	1.97	2.99	5.98	1.90	3.52	.32	0	T.	27.49
1892–93	.24	.38	10.30	5.56	3.29	3.40	8.99	3.61	.95	.16	0	0	36.88
1893–94	.48	.66	4.01	3.38	8.74	10.52	2.54	.89	2.78	.64	.02	T.	34.66
1894–95	1.64	2.98	.84	11.90	10.00	3.08	1.46	2.30	2.39	0	.01	0	36.60
1895–96	.08	.78	2.46	3.16	9.54	1.08	3.83	6.70	2.10	.03	T.	.28	30.04
1896–97	.47	1.91	5.77	4.93	3.50	5.92	3.40	.78	.27	.39	0	0	27.34
1897–98	.07	1.26	1.51	2.70	1.50	4.16	2.04	.83	2.41	.38	0	0	16.86
1898–99	.29	1.33	1.33	2.13	5.63	.75	11.11	1.40	1.47	.39	0	.12	25.95
1899–1900	T.	6.37	4.92	4.16	3.26	1.70	3.37	4.06	1.35	T.	.01	.02	29.22
1900–1901	.08	3.48	7.76	2.21	5.74	5.92	1.98	3.33	1.07	.02	0	.05	31.64
1901–2	1.07	2.29	2.89	1.61	1.47	9.25	5.18	2.98	1.19	0	0	0	27.93
21-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31.60

[a] Year incomplete.

Record of precipitation at Delta, Shasta County.

[Latitude, 41° 00′; longitude, 122° 23′; elevation, 1,138 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1882–83	0.10	9.20	8.14	3.94	1.00	0	14.46	8.49	9.94	0	0	0	55.27
1883–84	0	6.18	1.10	4.24	15.57	4.55	13.44	16.55	2.73	7.12	0.25	0	71.73
1884–85	1.03	6.01	.56	16.24	2.91	2.53	.37	2.54	.67	1.60	0	0	34.46
1885–86	0	.60	29.38	12.94	9.95	.50	3.52	10.19	8.16	.60	0	0	75.84
1886–87	T.	1.30	.30	8.81	3.84	10.27	3.37	5.53	1.26	.82	0	0	35.50
1887–88	0	0	.75	2.23	10.40	4.67	1.70	0	2.45	3.30	0	0	25.50
1888–89	(0.16)	(7.14)	(7.18)	10.56	.15	1.02	37.52	2.91	5.81	1.07	0	0	73.52
1889–90	0	26.71	10.03	25.83	17.18	21.11	16.50	4.78	2.33	0	0	0	124.47
1890–91	1.00	.40	0	7.24	3.72	13.70	2.06	8.95	4.76	1.98	.75	0	44.56
1891–92	1.31	2.24	1.99	7.21	5.55	4.01	8.34	6.31	5.22	.04	.10	0	42.32
1892–93	1.52	3.40	13.08	19.51	3.17	2.10	11.90	8.90	3.30	0	T.	0	66.88
1893–94	2.85	.15	8.05	3.10	14.30	3.70	2.60	2.75	3.50	2.25	0	T.	43.25
1894–95	4.00	7.33	3.30	33.17	18.55	7.03	7.72	1.71	6.85	0	1.07	0	90.73
1895–96	5.18	0	2.15	5.98	31.42	.60	11.81	16.72	6.92	.07	0	T.	80.85
1896–97	T.	3.50	12.00	17.23	4.66	7.13	4.63	1.30	0	2.75	0	0	53.20
1897–98	0	3.40	3.55	6.05	.75	13.55	0	1.35	5.85	1.40	0	0	35.90
1898–99	0	1.95	3.35	2.00	8.19	(6.13)	11.81	.65	1.10	4.05	0	0	39.23
1899–1900	0	9.85	19.60	6.40	12.25	4.60	9.45	8.59	4.10	1.56	.17	0.20	76.77
1900–1901	.97	15.68	10.51	8.04	13.43	9.28	1.58	6.81	.65	0	0	0	66.95
1901–2	2.28	2.95	11.27	5.55	2.92	39.82	8.48	7.70	4.02	.32	T.	.28	85.59
20-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61.13

Record of precipitation at Fort Crook, Shasta County.

[Latitude, 40° 10'; longitude, 121° 20'; elevation, 3,390 feet. Authority, U. S. War Department.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1857-58					2.23	4.38	2.57	1.28	0.13	0.34	0	0.03	[a] 10.96
1858-59	0.04	3.67	1.32	6.39	1.81	5.96	4.06	1.26	.60	0	0	.05	25.16
1859-60	1.80	0	3.85	1.00	2.14	.27	5.10	3.09	3.06	.44	2.22	0	22.97
1860-61	.23	2.97	1.33	5.04	1.20	4.78	4.03	1.82	1.33	.66	0	0	23.39
1861-62	0	.09	6.18	9.75	8.22	4.89	3.53	2.64	2.59	2.45	.02	0	40.36
1862-63	.40	.09	0	1.81	3.60	3.09	2.80	1.00	.40	0	0	0	13.19
1863-64	0	.39	.06	2.00	1.10	0	.58	1.00	1.34	.35	0	0	6.82
1864-65	0	1.05	7.00	7.47	3.16	2.16	2.23	1.20	1.30	.60	0	0	26.17
1865-66	1.02	1.55	8.75				8.25	.87					[a] 20.44
1866-67	0	0	.80	11.75	5.27	4.44	.75	1.86	.50	.30	0	0	25.67
1867-68	.80	.73	1.12							1.67	.16	0	[a] 4.48
1868-69	0	.50	.56	3.25	2.85		4.82	1.56					[a] 13.54
8-year mean													22.97

[a] Year incomplete.

Record of precipitation at Redding, Shasta County.

[Latitude, 40° 36'; longitude, 122° 27'; elevation, 565 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1890-91					1.68	9.95	3.05	2.31	3.17	1.91	0.75	0	[a] 22.82
1891-92	0.13	0.02	0.08	8.36	1.19	1.32	1.41	2.31	3.23	.20	0	0	18.25
1892-93	0	2.46	8.96	14.27	4.18	4.75	9.17	3.94	1.35	0	0	0	49.08
1893-94	3.05	.27	7.60	3.97	9.69	7.65	3.20	2.60	1.31	.65	0	0.42	40.41
1894-95	1.59	5.85	.99	15.35	12.84	3.08	2.78	.99	2.61	0	.95	T.	47.03
1895-96	3.24	.01	2.12	4.36	14.52	.79	4.17	4.65	8.97	.35	T.	.38	42.96
1896-97	.81	1.99	6.30	8.98	4.42	6.80	5.29	3.02	0	1.59	0	0	39.20
1897-98	.15	1.36	1.69	3.60	.54	3.77	0	.76	3.64	.15	0	T.	15.66
1898-99	.13	1.56	2.23	2.35	9.66	1.04	8.86	.61	.82	2.46	0	.08	29.80
1899-1900	0	4.83	8.50	4.18	6.45	2.86	3.68	2.59	3.12	1.38	T.	.16	37.75
1900-1901	2.48	6.47	3.03	3.14	6.33	5.52	.57	5.11	.41	T.	.01	T.	33.07
1901-2	3.11	3.08	6.45	4.37	1.37	19.97	4.73	4.69	2.94	0	.01	.03	50.75
11-year mean													36.72

[a] Year incomplete.

Record of precipitation at Sims, Shasta County.

[Latitude, 41° 05'; longitude, 122° 21'; elevation, 1,387 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1887-88							4.74	1.00	2.53	4.37	0.14	0	[a] 12.78
1888-89	0.10	0		9.21	0.42			1.87	3.55	2.73	0	0	[a] 17.88
1889-90	0	28.57	13.32	19.85	17.84	18.30	19.83	5.53	2.64	.65	0	0	126.53
1890-91	1.41	0	0	8.80	4.01	5.29	2.85	6.03	4.36	2.17	.40	0	35.35
1891-92	1.50	1.08	3.51	7.36	1.12	4.39	8.81	8.39	7.27	.74	.19	0	47.36
1892-93	1.21	1.64	13.39	26.92	3.50	4.39	8.94	9.67	4.57	T.	0	0	74.26
1893-94				3.48	10.98	4.40	6.37	1.00	3.42	2.52	T.	0.36	[a] 32.53
1894-95	2.40	1.05											[a] 4.45
9-year mean													70.88

[a] Year incomplete.

Record of precipitation at Coles, Siskiyou County.

[Latitude, 42° 00′; longitude, 122° 39′; elevation, 2,905 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1887–88	.....	.....	.....	.....	.....	.....	1.21	0.24	1.90	2.79	0.85	T.	[a] 6.99
1888–89	0.85	0	1.43	1.32	.....	0.15	2.20	.96	2.74	.10	.....	.....	[a] 9.75

[a] Year incomplete.

Record of precipitation at Dunsmuir, Siskiyou County.

[Latitude, 41° 12′; longitude, 122° 16′; elevation, 2,285 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888–89	0	0	6.83	2.95	0.30	0.33	4.39	2.43	7.06	1.12	0	0	25.41
1889–90	0	20.15	11.65	20.57	23.60	16.50	11.85	11.85	2.45	.40	0	0	119.02
1890–91	0.90	0	0	8.05	.55	2.59	2.70	4.95	3.07	2.88	0.67	0.07	26.43
1891–92	1.52	2.13	2.32	9.65	2.41	3.31	5.30	5.48	3.96	1.22	.35	0	37.65
1892–93	.05	2.68	7.47	14.03	3.65	6.40	13.30	8.75	4.06	0	.20	0	60.59
1893–94	3.27	1.15	11.35	5.08	17.53	7.60	6.05	1.70	4.35	2.10	0	0	60.18
1894–95	.20	9.65	2.90	29.30	15.30	6.50	8.15	2.55	4.40	0	1.55	0	80.50
1895–96	5.75	.05	1.40	4.39	22.25	1.54	10.23	11.43	6.22	.17	.34	0	63.77
1896–97	1.46	0	11.07	13.94	4.08	10.63	6.33	1.02	.14	2.35	0	0	51.02
1897–98	0	2.78	4.34	4.98	9.76	10.62	0	1.20	4.20	1.50	0	0	39.38
1898–99	.53	1.71	2.98	11.43	6.80	.50	10.31	.48	1.60	1.90	0	.90	39.14
1899–1900	T.	7.10	15.29	7.40	9.93	3.32	6.27	4.85	3.18	.90	0	T.	58.24
1900–1901	1.20	6.13	7.16	8.29	8.93	6.90	1.92	2.58	T.	0	0	0	43.11
1901–2	0	0	10.88	5.06	2.69	29.40	3.76	1.21	1.74	0	T.	.05	54.79
14-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54.23

Record of precipitation at Edgewood, Siskiyou County.

[Latitude, 41° 28′; longitude, 122° 23′; elevation, 2,955 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888–89	0.89	0.15	2.00	0.75	0.30	0.10	8.43	0.69	2.30	0.11	0.33	0	16.05
1889–90	0	7.80	2.35	5.30	5.60	5.90	5.04	.70	1.60	1.72	0	0.45	36.46
1890–91	1.05	.22	0.	3.00	.55	2.45	.18	1.96	2.04	1.45	.67	.05	13.62
1891–92	.84	.43	.20	2.80	.15	.12	2.67	.86	1.63	.69	.80	0	11.19
1892–93	.58	1.07	5.35	7.88	.95	.20	2.90	3.48	.95	.30	.66	0	24.32
1893–94	1.51	.76	2.65	.85	5.13	.50	1.83	.15	3.56	.72	0	.46	18.12
1894–95	.69	1.75	.82	9.55	4.56	.36	2.84	.08	.73	0	0	.94	22.32
1895–96	1.59	.05	.75	.51	6.64	.30	2.68	4.66	1.35	.42	.07	.77	19.79
1896–97	.71	.40	3.45	5.16	1.18	1.63	1.85	.15	2.03	1.78	0	.35	18.69
1897–98	0	1.27	1.90	2.68	.90	4.75	.17	1.64	2.49	.51	0	.99	17.30
1898–99	T.	.78	1.51	0	0	.52	1.67	.19	1.72	.29	0	.42	7.10
1899–1900	0	1.87	3.79	2.21	3.37	.91	1.85	2.25	1.58	.85	.11	.23	19.02
1900–1901	.68	4.97	.91	2.77	1.00	3.21	.18	1.02	.98	0	.48	.65	16.85
1901–2	1.16	0	2.28	2.24	.37	7.88	2.46	3.47	.97	.10	.32	.86	22.11
14-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18.78

Record of precipitation at Fort Jones, Siskiyou County.

[Latitude, 41° 35′; longitude, 122° 51′; elevation, 2,570 feet. Authority, U. S. War Department.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1850-51					3.78	1.38	3.39	1.02	1.17	0.41	0.13	.....	[a] 11.28
1851-52	0.00	0.48	4.47	1.19	.54	2.62	.75	1.99	.21	.63	.20	0.21	13.49
1852-53	0	4.18	.48	1.13	1.58	3.83	5.24	1.50	.87	.08	0	0	18.89
1853-54	.80	1.40	1.77	6.47	1.59	.42	1.18	1.84	2.77	.69	0	.20	18.44
1854-55	0	.13	1.78	8.93	3.62	7.59	2.35	0	.69	1.86	0	0	26.95
1855-56	.60	.80	4.47	4.24	6.15	8.78	3.69	1.15	1.55	.60	0	0	32.03
5-year mean													21.96

[a] Year incomplete.

Record of precipitation at Hornbrook, Siskiyou County.

[Latitude, 41° 50′; longitude, 122° 50′; elevation, 2,154 feet. Authority, Pacific Railway System.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1887-88	0.15	0.12	0.92	2.58	1.16	1.08	0.61	T.	2.58	2.74	0.15	0.17	12.26
1888-89	.32	0	2.57	2.94	.60	.10	2.07	0.43	2.34	0	0	0	11.37
1889-90	0	1.95	2.93	2.92	6.00	9.91	.70	.20	.44	.60	.85	.46	26.96
1890-91	0	0	0	1.90	.35	2.99	.67	.90	2.40	1.60	.35	0	11.16
1891-92	.55	.65	.70	4.55	.70	.35	1.40	1.50	.50	.60	0	0	11.50
1892-93	.45	.68	2.65	3.98	1.05	1.15	.30	1.50	1.20	T.	.95	0	13.91
1893-94	.80	1.60	4.17	3.33	3.20	.70	1.50	0	3.78	1.12	0	0	20.20
1894-95	0	1.30	.70	2.30	2.40	.20	2.69	.20	1.20	1.50	.60	.60	13.69
1895-96	.55	0	.60	2.95	6.30	.90	2.47	2.00	1.80	0	.80	.57	18.94
1896-97	.58	2.02	6.04	5.85	.85	2.10	.80	.40	0	0	0	0	18.64
1897-98	0	.60	4.48	3.18	2.95	.10	0	0	.81	0	0	0	12.12
1898-99	.28	1.45	3.02	.77	2.17	.63	3.90	0	.10	.10	0	T.	12.42
1899-1900	0	1.27	4.66	2.80	3.24	.02	6.10	.57	.46	.55	0	0	19.67
1900-1901	0	3.81	3.96	3.13	3.60	2.13	.10	0	.13	0	0	.10	16.96
1901-2	1.10	.70	1.17	.93	0	4.96	.55	1.11	1.27	.51	T.	.60	12.90
15-year mean													15.51

Record of precipitation at Montague, Siskiyou County.

[Latitude, 41° 44′; longitude, 122° 31′; elevation, 2,542 feet. Authority, Pacific Railway System.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888-89	0.61	0.16	0.98	0.30	0.50	0.04	1.78	0.55	1.70	0.60	0	0	7.22
1889-90	0	3.20	1.60	3.74	3.70	6.05	3.60	.33	.82	1.15	0	0.35	24.54
1890-91	.90	0	0	1.40	.70	2.33	.75	.45	1.74	1.25	.45	0	9.97
1891-92	.15	.20	.35	1.83	.10	T.	.75	.40	1.40	0	.35	0	5.53
1892-93	0	0	1.25	2.21	.51	1.88	.87	1.75	.44	0	0	0	8.91
1893-94	.72	.44	3.05	2.34	2.72	2.13	2.28	.05	2.50	1.04	0	0	17.27
1894-95	0	1.00	.54	1.75	2.25	.55	.40	0	.81	0	T.	0	7.30
1895-96	.14	0	.56	1.58	3.40	.40	1.49	.81	.96	0	0	.48	10.12
1896-97	0	0	2.25	1.43	1.49	2.66	1.35	0	.0	1.11	0	0	10.29
1897-98	0	0	.76	1.63	.30	1.63	.10	0	.80	0	0	0	5.22
1898-99	0	.16	2.18	.20	.72	.22	1.50	.20	.60	.53	0	.56	6.87
1899-1900	[illegible]	.90	3.15	2.95									[a] 7.00
11-year mean													10.29

[a] Year incomplete.

Record of precipitation at Scott Valley, Siskiyou County.

[Latitude, 41° 45′; longitude, 123° 02′; elevation, 2,570 feet. Authority, Isaac Titcomb.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1858–59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.50	[a]0.50
1859–60	0.87	1.00	4.33	0.75	2.59	1.25	4.12	0.75	2.00	0.50	1.62	.24	20.02
1860–61	.49	2.22	2.00	5.74	1.12	2.50	2.50	3.00	.54	.30	0	0	20.41
1861–62	0	.51	11.56	10.63	9.29	3.75	1.32	2.00	1.00	.80	.10	0	40.96
1862–63	.02	.15	.12	1.90	4.75	1.75	2.45	2.00	.40	1.93	.25	.09	15.81
1863–64	.40	.25	1.85	6.17	2.07	.43	.82	2.70	.51	.31	0	.63	16.14
1864–65	.04	.31	6.00	12.75	1.87	2.40	1.30	.32	.05	.75	.35	.02	26.16
1865–66	1.15	1.33	9.79	1.21	6.59	3.50	9.20	.02	1.72	.62	.50	.47	36.10
1866–67	0	.08	2.51	11.75	9.12	2.02	.64	1.34	.41	.04	0	.26	28.17
1867–68	.40	.88	1.75	9.68	3.06	1.50	3.70	1.14	.18	1.06	0	0	23.35
1868–69	.06	.50	.77	2.80	5.76	1.13	1.32	3.61	1.52	.69	.13	0	18.29
1869–70	1.00	.01	3.04	3.56	5.00	2.91	1.73	1.37	1.12	.13	0	0	19.87
1870–71	.01	.02	1.00	3.50	1.86	2.47	1.62	2.27	.55	.26	.35	0	13.91
1871–72	.37	.05	1.62	7.68	4.18	6.94	1.40	.34	.25	.03	.01	.01	22.88
1872–73	.41	.16	2.67	3.38	1.33	3.00	1.05	1.50	.27	.03	.03	.05	13.88
1873–74	.37	.94	1.71	4.49	6.38	1.80	3.65	1.55	.71	.13	.01	.09	21.83
1874–75	0	1.55	4.33	.43	3.13	.17	1.79	.35	.75	.12	.38	.05	13.05
1875–76	0	4.45	7.31	7.33	2.26	3.33	3.94	.71	1.19	.18	.34	1.50	32.54
1876–77	1.02	3.75	.54	.01	1.71	4.23	3.10	1.23	1.48	.71	.12	.02	17.92
1877–78	.01	.45	.67	1.62	9.72	6.53	3.74	.27	.20	.12	.01	.06	23.40
1878–79	.36	2.81	2.16	1.14	3.25	3.54	8.39	2.66	1.40	.27	.38	.47	26.83
1879–80	.11	.81	4.64	4.58	10.62	2.32	2.65	5.39	1.32	.02	.37	.07	32.90
1880–81	0	.18	.32	6.76	13.95	6.53	.79	1.19	.17	1.04	.54	.04	31.51
1881–82	.76	3.53	2.40	4.60	4.48	5.69	2.22	2.45	1.29	.08	2.49	0	29.99
1882–83	1.44	2.86	2.72	3.75	2.58	1.51	1.11	3.25	2.65	0	.40	.63	22.90
1883–84	.66	2.41	1.11	4.75	4.28	3.14	3.45	3.06	1.65	.87	1.62	.01	27.01
1884–85	.60	1.04	.16	8.18	2.50	3.49	.11	1.98	1.40	1.40	1.16	.01	22.03
1885–86	.83	.53	10.24	3.26	7.22	1.32	1.32	3.23	1.77	.03	2.13	.85	32.73
1886–87	0	1.85	.78	6.67	5.18	4.96	1.07	2.63	.94	.36	.37	.18	24.99
1887–88	.36	.09	1.75	5.88	6.18	1.77	2.43	.18	1.80	4.21	.60	.11	25.36
1888–89	.58	.40	1.94	1.59	2.71	.50	4.35	2.56	4.71	.19	1.11	0	20.64
1889–90	0	3.95	3.37	12.84	21.81	11.10	.....	.....	.....	.....	.....	.....	[a]53.07
30-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24.05

[a] Year incomplete.

Record of precipitation at Sissons, Siskiyou County.

[Latitude, 41° 27′; longitude, 122° 25′; elevation, 3,555 feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1881–82	0.99	2.53	3.34	8.54	6.35	2.90	1.74	1.65	0.60	0	0	0	28.64
1882–83	1.19	4.44	3.20	1.65	.99	1.10	10.15	6.15	0	0	0	0	28.87
1888–89	.40	3.70	2.17	2.91	.60	.40	16.27	.63	2.40	0.23	0	0	29.71
1889–90	0	16.45	5.80	16.13	5.69	9.33	5.30	2.98	2.75	.44	0	0	64.87
1890–91	1.20	.13	0	3.18	.40	7.17	.61	3.64	2.65	.44	0.60	0	20.02
1891–92	.32	.30	.35	11.20	2.34	.66	4.19	5.38	3.74	.39	0	0	28.87
1892–93	1.71	1.03	8.75	9.57	3.10	2.80	2.77	2.60	2.66	.03	0	0	35.02
1893–94	.68	.61	4.25	2.87	10.72	2.60	3.45	.70	2.85	2.25	0	0	30.98
1894–95	.99	3.65	1.70	11.13	9.12	1.24	3.84	1.27	2.05	0	.55	0	35.54
1895–96	4.65	3.70	.70	4.31	21.09	.21	4.16	3.55	3.02	0	.13	0.31	45.83
1896–97	.....	.....	.....	.....	2.59	4.86	.43	.53	0	.15	0	0	[a]8.56
1897–98	0	2.31	2.62	3.72	0	10.45	4.70	1.05	6.13	1.03	.13	0	32.14
1898–99	0	0	1.70	2.10	5.55	1.03	2.98	.23	1.32	.89	0	1.32	17.12
1899–1900	0	4.01	10.83	5.67	8.64	1.04	9.92	3.49	2.05	1.24	0	.16	47.05
1900–1901	.67	10.76	4.52	3.80	11.97	8.99	.62	2.73	.95	0	26	.36	45.63
1901–2	2.08	1.93	6.58	2.77	1.83	21.73	4.14	5.08	2.87	T.	.38	4.16	53.55
15-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.26

[a] Year incomplete.

Record of precipitation at Walla Walla Creek, Siskiyou County.

[Latitude, 41° 12′; longitude, 122° 55′; elevation, 3,000 feet. Authority, S. Titcomb.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888-89					1.86	0.25	3.85	1.66	3.46	0.19	1.11	0	[a]12.38
1889-90	0	3.95	3.37	8.09	11.86	9.10	4.93	1.24	1.29	.28	0	0.85	44.96
1890-91	1.84	.10	.19	3.85	1.70	6.13	2.03	1.11	3.28	.99	.22	.40	21.84
1891-92	1.18	.39	1.10	12.40	2.38	.47	2.39	2.94	1.29	.76	.35	0	25.65
1892-93	.82												[a].82
3-year mean													30.82

[a] Year incomplete.

Record of precipitation at Yreka, Siskiyou County.

[Latitude, 41° 45′; longitude, 122° 32′; elevation, 2,635 feet. Authority, Dr. L. Antervinth].

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1871-72	0.33	1.24	1.98	2.61	3.83	1.91	1.67	2.04	0.44	0	0.14	0	16.19
1872-73	.25	1.55	1.43	3.92	1.28	1.77	.40	.90	.60	0	0	0	12.10
1873-74	.44	.55	1.17	2.20	3.78	1.62	1.49	.74	.34	0.44	0	0	12.77
1874-75	0	1.29	2.16	0	4.35	.19	1.49	.17	.51	.30	.07	0	10.53
1875-76	0	3.34	5.29	6.07	2.00	1.93	2.07	.42	.65	.20	.32	0.19	22.48
1876-77	.90	3.05	.43	.26	1.20	3.24	1.48	.74	1.56	.65	.18	0	13.69
1877-78	.90	.20	3.84	.95	6.12	3.91	2.80	.37	.56	0	.75	0	20.40
1878-79	.25	.45	1.15	.45	1.53	1.41	3.96	1.56	1.42	.39	.22	.15	12.94
1879-80	.25	.77	2.32	7.23	2.43	.61	1.20	2.23	.41	.15	0	0	17.60
1880-81	0	.13	.10	2.42	11.78	2.58	.19	.48	0	1.23	0	0	18.91
1881-82	.30	3.24	.68	1.60	1.81	1.96	.42	1.20	1.02	0	0	0	12.23
1882-83	.90	1.88	1.89	2.09	1.38	.47	.53	1.26	1.76	0	.33	.25	12.74
1883-84	.33	1.35	.66	2.95	2.10	1.20	2.34	1.41	1.40	1.78	1.33	.51	17.36
1884-85	.33	0	.79	6.19	1.16	2.94	0	1.12	3.65	1.66	.58	0	18.42
1885-86	.49	.29	2.98	2.10	4.03	.91	.74	1.78	1.05	0	1.51	.15	16.03
1886-87	0	1.69	.30	4.14	3.21	3.01	.41	2.35	1.42	.84	1.28	.31	18.96
1887-88	.21	0	1.04	1.99	4.90	1.19	1.16	.11	1.12	2.39	.24	0	14.35
1888-89	.87	.34	1.13	0	1.30	1.30	2.12	1.32	1.70	.10	.94	0	11.12
1889-90	0	3.53	2.23	4.08	3.59	8.89	3.09						[a]25.41
1890-91						3.59	1.15	.93	1.48	1.36	.41	0	[a]8.92
1891-92	.82	.43	2.20	3.92	1.65	.15	1.02	1.02	1.20	.87	.31	0	13.59
1892-93	.61	.05	3.37	3.64	1.20	2.53	1.53	2.10	.87	.32	.58	.08	16.88
1893-94	1.12	.54	7.83	2.11	7.59	3.22	3.32	.10	3.31	.70	.77	.41	31.02
1894-95	.01	1.60	.57	5.40	5.30	1.03	2.26	.81	1.59	0	.43	.68	19.68
1895-96	.82	T.	.86	4.31	7.37	1.08	1.89	2.28	2.75	.81	.73	1.01	23.91
1896-97	.52	.89	5.02	3.70	.42	3.89	2.18	.39	.58	1.51	0	.20	19.30
1897-98	.12	.68	2.94	3.76	.83	1.44	.42	.48	2.08	.10	.02	.05	12.92
1898-99	.14	.51	2.74	1.04	2.75	1.95	1.77	.21	.62	.61	.03	.12	12.49
1899-1900	.07	2.34	5.00	3.80	1.35	2.13	1.12	.42	.37	1.36	0	1.35	19.31
1900-1901	.43	3.66	2.00	3.23	8.12	2.86	.98	.40	.52	0	.01	.95	23.16
1901-2	1.24	1.28	1.81	3.09	.39	6.68	1.53	1.21	1.08	.03	.19	.01	18.54
29-year mean													16.88

[a] Year incomplete.

Record of precipitation at Weaverville, Trinity County.

[Latitude, 40° 46′; longitude, 123° 25′; elevation, 2,162 feet. Authority, George E. Noonan.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1869–70	1.06	1.03	8.01	6.15	10.11	9.64	2.05	1.06	0.22	0	0	0	39.33
1870–71	.64	1.39	6.41	9.43	8.16	11.19	3.02	1.73	1.03	0.14	0	0	43.14
1871–72	.29	.40	11.50	3.52	19.62	15.09	3.11	2.43	.84	.17	0	0.25	57.22
1872–73	.35	.78	3.01	6.32	6.51	4.29	2.78	.50	.27	0	0	0	24.81
1873–74	1.80	4.39	4.02	9.57	15.40	4.41	3.12	3.58	2.67	.70	0	0	49.66
1874–75	0	1.57	10.30	1.32	6.59	.46	2.14	.19	1.22	.93	0	0	24.72
1875–76	0	2.82	15.39	11.94	9.69	9.49	8.23	2.79	1.63	.15	0.47	0	62.60
1876–77	.67	7.38	1.50	.29	6.27	6.24	4.52	2.26	1.62	1.72	.02	.21	32.70
1877–78	0	1.83	8.72	6.50	19.83	16.20	8.53	2.42	1.07	.07	.02	.03	65.22
1878–79	1.28	1.80	3.58	4.91	2.02	6.48	12.84	4.05	4.02	.68	.02	.03	41.71
1879–80	.03	2.08	8.09	13.20	6.64	2.59	4.72	10.78	1.46	.23	.38	.36	50.56
1880–81	0	.55	1.49	14.14	18.61	11.05	1.21	3.13	1.15	.99	0	0	52.32
1881–82	.93	3.77	2.58	8.00	4.19	6.90	3.62	2.44	1.29	0	0	0	33.72
1882–83	1.38	8.36	.78	5.05	4.46	1.50	3.24	5.00	3.72	0	0	0	33.49
1883–84	.88	2.45	1.50	4.97	8.81	3.56	5.10	6.29	1.60	2.93	.13	0	38.22
1884–85	.44	.11	16.56	6.78	3.68	3.70	.15	2.78	.51	1.41	0	0	36.12
1885–86					8.71	.80	2.94						[a] 12.45
16-year mean													42.85
1893–94					11.47	5.02	4.60		2.22				[a] 23.31

[a] Year incomplete.

Record of precipitation at Milo, Tulare County.

[Latitude, 36° 15′; longitude, 118° 50′; elevation, 3,200 feet. Authority, Henry Murphy.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900–1901					5.74	4.06	1.33	2.45	3.36	0	0	0	[a] 16.94
1901–2	0.51	1.80	1.47	0.27	1.00	6.47	4.33	1.69	.54	0	T.	0	18.08

[a] Year incomplete.

Record of precipitation at Mountain Home, Tulare County.

[Latitude, 36° 10′; longitude, 118° 48′; elevation, 6,680 feet. Authority, Fred Moller and N. T. Bailey.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895–96					14.36	0.84	8.93	8.63	1.30	2.70	0.65	0.50	[a] 37.91
1896–97		0.60	0.40	1.95	5.70	7.45	6.07	.40	1.85	.20	.25	0	[a] 24.87
1897–98	0.10	2.45	.73	3.31									[a] 6.59

[a] Year incomplete.

Record of precipitation at Porterville, Tulare County.

[Latitude, 36°; longitude, 119°; elevation, 461 feet. Authority, Southern Pacific Company, M. F. Murphy, agent.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1892-93			0.54	2.43	0.83	1.85	3.68	0.27	0	0	0	0	[a] 9.60
1893-94	0	0	.07	.61	1.52	.83	.70	.32	0.42	1.09	0	0	5.56
1894-95	0.43	.15	.04	3.13	3.82	1.54	1.10	.41	.35	0	0	0	10.97
1895-96	0	.23	1.71	.51	1.61	T.	.67	.82	.13	0	.69	0	6.37
1896-97	0	.65	.94	.93	1.96	2.46	2.00	.30	.42	0	0	0	9.66
1897-98	0	1.19	.50	.89	.75	1.55	.68	0	.55	0	0	0	6.11
1898-99	2.10	0	.27	.35	1.01	.17	2.92	.19	.10	.85	0	T.	7.96
1899-1900	0	1.08	.88	.91	.97	.16	.89	1.94	2.41	0	T.	0	9.24
1900-1901	T.	.04	3.44	.30	2.74	1.78	.30	2.19	1.97	0	0	T.	12.76
1901-2	.41	.45	71	T.	.84	2.96	2.28	1.53	.15	0	T.	0	9.33
10-year mean													8.76

[a] Year incomplete.

Record of precipitation at Crockers (Sequoia post-office), Tuolumne County.

[Latitude, 37° 50'; longitude, 119° 53'; elevation, 4,452 feet. Authority, H. R. Crocker.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1895-96												3.10	[a] 3.10
1896-97	0.14	2.30	9.18	5.41	6.56	15.97	21.80	1.33	0	0.75	0	0	63.44
1897-98	.45	6.09	2.70	3.80	2.60	7.15	3.74	1.10	3.74	0	0	0	31.37
1898-99	1.58	1.87	1.85	2.12	11.72	1.80	18.09	1.60	.15	1.65	0	0	42.43
1899-1900	0	11.50	7.45	12.18	5.98	1.18	[b] 4.28	3.56	1.80	.47	0	0	48.40
1900-1901	.62	9.71	17.43	1.39	16.99	15.71	3.03	6.35	3.81	0	0	0	75.04
1901-2	3.28	4.59	3.90	2.50	2.33	15.03	8.55	6.54	1.80	0	0	.11	48.63
6-year mean													51.55

[a] Year incomplete. [b] March, 1900, violent hailstorm.

Record of precipitation at Deving Creek (30 miles east of Sonora), Tuolumne County.

[Latitude, 38° 00'; longitude, 119° 40'; elevation, 7,000 feet.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1898-99		1.85	2.88	2.78	9.95	2.77	17.08	0.12					[a] 37.43

[a] Year incomplete.

Record of precipitation at Second Garotte, Tuolumne County.

[Latitude, 37° 33′ N.; longitude, 120° 24′; elevation, 2,714 feet. Authority, J. P. Chamberlain.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1882-83	.....	.....	.....	.....	1.25	4.52	8.27	2.00	3.50	0	0	0	[a] 19.54
1883-84	0.63	0.75	0.75	1.00	8.00	14.00	16.00	9.00	1.00	1.48	0	0	52.61
1884-85	0	2.00	0	18.50	4.00	0	0	1.50	0	3.50	0	0	29.50
1885-86	.25	0	18.00	5.00	10.00	1.00	5.50	6.25	.50	0	0	0	46.50
1886-87	0	1.00	1.75	2.75	1.00	13.75	1.25	5.50	0	0	0	0	27.00
1887-88	1.00	0	2.00	7.00	7.75	1.50	3.00	1.25	1.25	.25	0	0	25.00
1888-89	.50	0	5.00	4.25	.50	1.00	9.75	.50	5.75	0	0	0	27.25
1889-90	0	6.50	5.75	22.00	15.00	6.75	7.25	2.00	1.75	0	0	.25	67.25
1890-91	2.27	0	0	9.00	2.00	14.00	5.00	3.50	.25	0	0	0	36.02
1891-92	0	.25	0	11.25	2.25	3.25	7.00	2.00	6.25	0	0	0	32.25
1892-93	.25	1.25	10.00	8.75	6.00	7.25	11.25	2.50	0	0	0	0	47.25
1893-94	.50	.25	3.00	4.00	10.50	10.75	2.25	1.25	3.75	1.00	0	0	37.25
1894-95	2.00	2.00	.50	18.00	13.00	4.25	8.75	2.00	1.50	0	0	0	52.00
1895-96	0	0	1.75	2.75	12.00	0	5.55	7.25	.25	0	0	2.50	32.05
1896-97	0	3.00	6.00	4.50	4.00	10.75	9.01	.53	T.	T.	0	0	37.79
1897-98	T.	2.75	1.00	2.50	2.75	6.00	2.50	.25	2.50	0	0	0	20.25
1898-99	2.00	1.50	1.50	1.00	6.76	1.00	14.00	.53	1.00	T.	T.	0	29.29
1899-1900	0	6.72	6.75	6.00	5.25	1.25	3.75	4.00	1.50	0	0	0	35.22
1900-1901	.25	5.00	14.00	1.50	11.00	17.75	1.25	4.00	1.00	0	0	0	55.75
1901-2	2.25	2.25	2.00	2.00	1.25	11.75	4.75	3.25	1.00	.....	.....	.....	[a] 30.50
18-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38.35

[a] Year incomplete.

Record of precipitation at Sonora, Tuolumne County.

[Latitude, 37° 58′; longitude, 120° 22′; elevation, 1,900 feet. Authority, John Shaw.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1887-88	0.64	0	0.70	5.76	7.92	1.32	3.91	0.25	1.02	0.23	0	0	21.75
1888-89	.54	0	4.45	5.04	.88	1.75	7.22	.96	4.77	.05	0	0	25.66
1889-90	0	6.83	7.04	18.25	13.59	9.27	7.40	2.66	2.35	0	0	0	67.39
1890-91	1.69	.09	.10	10.23	1.74	9.60	3.79	3.77	.60	.68	0	0	32.29
1891-92	.36	.37	.08	9.10	1.69	4.20	6.40	2.93	5.18	.09	0	0	30.40
1892-93	.38	1.88	10.28	6.52	4.88	5.93	11.11	2.51	.27	0	0	T.	43.76
1893-94	.53	.35	3.39	3.87	8.76	11.46	2.39	1.32	3.96	1.48	T.	0.02	37.53
1894-95	1.21	4.74	0	14.53	11.19	4.62	4.01	3.25	2.40	0	0	0	45.95
1895-96	.61	.21	.75	2.51	10.80	.49	5.00	8.65	1.14	0	0.40	.61	31.17
1896-97	.25	2.85	6.74	3.97	3.31	11.89	8.37	.29	.25	.31	0	0	38.23
1897-98	.10	3.35	2.15	2.53	1.71	5.79	1.96	.60	2.70	.15	0	0	21.04
1898-99	.87	.84	1.51	2.64	6.99	.42	14.03	1.08	2.18	2.17	0	.08	32.81
1899-1900	0	6.90	7.02	5.38	3.20	1.37	2.75	4.28	2.01	.20	0	.03	33.14
1900-1901	.14	5.10	10.29	2.05	9.04	12.89	1.26	4.73	1.18	.07	0	.04	46.79
1901-2	2.42	1.81	3.15	2.40	1.35	7.86	5.53	2.45	1.44	0	0	.01	28.42
15-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35.76

Record of precipitation at Frazier mine, Ventura County.

[Latitude, 34° 45′; longitude, 118° 00′; elevation, 8,000 feet. Authority, Harry C. Porter.]

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1894-95	.....	.....	.....	.....	.....	.....	.....	.....	0.40	0	0	0	[a] 0.40
1895-96	0	0.30	0.90	0.68	2.94	0	3.12	2.22	1.03	0	0.15	3.73	15.07
1896-97	0	1.47	.73	4.07	7.37	6.33	4.05	.16	.28	0	.02	.48	24.96
1897-98	0.33	1.00	T.	1.35	.....	.....	.....	.....	.....	.....	.....	.....	[a] 2.68
1898-99	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.60	·0	.....	[a] .60
2-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20.02

[a] Year incomplete.

Record of precipitation at Mutah Flat, Ventura County.

[Latitude, 34° 38′; longitude, 119° 03′; elevation, 4,850 feet. Authority, Burt Snedden Griffen.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1893-94	0.22	1.70	0	4.10	0.54	1.41	0.30	0.13	0.79	0	0	0	9.19
1894-95	0	.85	0	7.33	9.80	.78	2.95	0	0	0	0	0	21.71
1895-96	0	.65	1.60	1.10	4.58	0	4.79	3.50	.52	0	0.30	0	17.04
1896-97	0	1.75	1.50	2.80	9.10	3.50	3.59	0	0	0	.30	0	22.54
1897-98	0	1.75	0	.15	.60	1.00	.80	0	.60	0.40	0	0	5.30
1898-99	1.80	0	0	.30	2.25	0	2.50	.50	0	0	0	0	7.35
1899-1900	0	2.00	1.30	2.25	2.80	0	1.95	.40	1.80	0	0	0	12.50
1900-1901	0	0	5.10	0	7.00	4.60	.25	1.10	.58	0	0	0	18.63
1901-2	0	2.85	.65	0	.75	3.23	2.80	1.41	0	0	0	0	11.69
9-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.99

Record of precipitation at Nordhoff, Ventura County.

[Latitude, 34° 27′; longitude, 119° 08′; elevation, 1,200 feet. Authority, R. Robinson, J. W. Wolf, and H. Lathrop.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1886-87	0	0.36	1.10	0.78	0.22	16.81	0.44	1.88	0.18	.....	.....	.....	[a] 21.77
1887-88	.....	.....	1.63	5.29	7.46	1.28	5.47	.54	.26	.....	.....	.....	[a] 21.93
1888-89	.....	0	5.96	7.22	0	.....	.....	.....	.....	.....	.....	.....	[a] 13.18
1890-91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	0	[a] 0
91-92	0.25	0	T.	2.58	.67	2.75	3.68	.47	1.39	0	0	0	11.79
1892-93	0	1.08	1.35	8.75	5.80	3.64	7.75	.45	T.	0	0	0	28.82
1893-94	0	.61	T.	3.45	.68	.74	.29	.19	.97	0	0.03	0	6.96
1894-95	.03	.45	0	6.39	8.61	.46	3.66	.39	0	0	0	0	19.99
1895-96	0	.10	1.09	0	5.78	0	3.42	1.72	0	0	.22	T.	12.33
1896-97	0	1.38	1.03	3.00	4.11	7.16	2.91	0	0	0	0	0	19.59
1897-98	.....	.....	.....	.....	.....	.....	.43	0	.....	0	0	0	[a] .43
1898-99	0	.13	.....	.....	3.98	.....	2.71	.27	0	0	.....	0	[a] 7.09
1899-1900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.13
1900-1901	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.37
1901-2	.25	4.38	1.25	0	1.37	5.50	4.13	2.50	0	0	0	0	19.38
9-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.15

[a] Year incomplete.

Record of precipitation at Smith's ranch, Ventura County.

[Latitude, 34° 44′; longitude, 118° 47′; elevation, 4,000 feet. Authority, William Smith, Gorman Station.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1898-99	.....	.....	.....	.....	0.82	1.00	1.45	0	0	0	0	0	[a] 3.27
1899-1900	0	0.95	0.65	0.35	1.20	0	1.12	0.12	0.75	0	0	0	5.14
1900-1901	0.15	0	3.10	0	2.35	2.25	.10	.32	.45	0	0	0.95	9.67
1901-2	.10	.25	.20	0	.....	.....	.....	.....	.....	.....	.....	.....	[a] .55
2-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7.41

[a] Year incomplete.

Record of precipitation at Snedden's ranch, Ventura County.

[Latitude, 34° 41′; longitude, 119° 03′; elevation, 4,900 feet. Authority, Burt Snedden Griffin.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1892-93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.14	0.02	[a] 0.16
1893-94	0.03	0.72	0	4.45	1.31	0.65	0.45	0.16	0.75	0	0	1.15	9.67
1894-95	.75	0	0	6.99	6.31	.49	1.50	.11	0	0	0	0	16.15
1895-96	0	.16	0.91	.55	3.47	0	5.02	3.79	.57	0	.25	T.	14.72
1896-97	.33	1.10	1.35	2.40	8.30	2.92	2.71	.02	0	0	.25	.20	19.58
1897-98	.14	.70	0	.05	.60	.41	.65	0	.54	0.35	0	0	3.44
1898-99	1.75	0	0	.30	2.65	0	1.50	.50	0	0	0	0	6.70
1899-1900	0	1.50	.47	.27	1.40	T.	1.45	.50	1.40	0	0	0	6.99
1900-1901	0	0	4.52	0	3.70	3.80	.10	1.10	.47	0	0	0	13.69
1901-2	0	1.75	1.75	0	.56	2.95	1.85	.50	0	0	0	0	9.36
9-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11.14

[a] Year incomplete.

Record of precipitation at Upper Lake, Ventura County.

[Latitude, 34° 41′; longitude, 119° 03′; elevation, 4,900 feet. Authority, U. S. Weather Bureau.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1890-91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	[a] 0
1891-92	0.95	0.62	0.71	7.35	3.93	2.50	3.18	2.84	3.71	0.49	0	0	26.28
1892-93	T.	1.17	3.50	5.30	4.08	5.19	5.47	2.37	1.04	0	T.	0	28.12
1893-94	.85	.47	4.83	2.82	10.43	6.21	1.80	1.46	1.02	1.12	0	T.	31.01
1894-95	.53	2.05	1.13	11.62	14.92	4.15	3.20	1.41	1.39	0	0.05	T.	40.45
1895-96	.46	T.	3.50	5.30	11.18	.80	2.39	6.01	2.07	0	T.	0.87	32.58
1896-97	.42	1.04	5.07	6.47	3.45	6.35	4.58	.42	.22	.97	.05	0	29.04
1897-98	.08	1.67	2.38	2.61	.93	4.57	.36	.43	1.90	.58	0	T.	15.51
1898-99	.60	1.01	1.66	1.34	8.16	.25	5.59	.90	1.00	.05	0	.03	20.59
1899-1900	0	3.49	6.33	9.79	3.98	1.31	3.53	2.13	.81	.35	T.	0	31.72
1900-1901	.03	3.96	5.08	3.63	6.44	4.75	1.06	2.43	.70	0	T.	T.	28.08
1901-2	1.11	1.09	4.35	2.09	1.35	12.82	3.87	2.85	1.60	0	0	.07	31.20
11-year mean	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.60

[a] Year incomplete.

Record of precipitation at Ventura, Ventura County.

[Latitude, 34° 20′; longitude, 119° 20′; elevation, 50 feet. Authority, Mr. Saxby.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1873-74	0	0	0.50	4.50	3.75	4.75	1.00	0	0.50	0	0	0	15.00
1874-75	0	0.50	.75	0	13.75	.12	.12	0	0	0	0	0	15.24
1875-76	0	0	5.00	.25	7.75	5.75	2.25	0	0	0	0	0	21.00
1876-77	0	0	0	0	3.60	0	.50	0.37	.75	0	0	0	11.62
1877-78	0	0	3.65	0	4.10	8.51	1.45	2.26	.25	0	0	0	20.22
1878-79	0	.34	0	4.07	4.67	1.09	.23	2.14	.25	0	0	0	12.79
1879-80	0	.57	1.91	4.98	1.41	7.63	1.95	3.61	0	0	0	0	22.06
1880-81	0	.25	.84	8.19	2.47	.18	1.53	.45	0	0	0	0	13.91
1881-82	0.06	1.98	.25	.81	.60	2.79	4.20	1.23	.06	0	0	0	11.98
1882-83	0	.31	.71	.10	3.48	2.35	1.95	.18	2.41	0.02	0	0	11.51
1883-84	0	1.00	0	4.46	7.38	9.96	9.44	2.06	.13	1.70	0	0	36.13
1884-85	0	.38	.84	4.95	1.25	.23	1.58	.23	0	0	0	0	9.46
1885-86	0	.03	.33	1.03	6.16	.34	2.27	1.97	.09	0	0	0	20.22
1886-87	0	.02	.94	.64	.20	11.08	.39	1.37	.11	0	0	0	14.75
1887-88	.06	.02	2.71	2.86	8.19	1.62	4.51	.34	0	0	0	0	20.31
1888-89	0	.04	4.47	4.39	.20	1.46	5.64	0	.65	0	0	0	16.85
1889-90	0	4.45	2.85	11.04	5.01	1.85	.45	0	0	0	0	0.03	25.68
1890-91	.84	0	.40	2.69	.45	7.12	3.10	.60	.16	0	0	0	15.36
1891-92	.98	0	0	1.75	1.05	4.54	.29	0	0	0	0	0	8.61
1892-93	0	.70	2.15	5.80	3.17	3.02	7.88	.42	.40	0	0	0	23.54
1893-94	0	.85	.25	2.04	.81	.50	.27	.17	.50	0	0	0	5.39
1894-95	.95	.10	0	3.13	5.25	1.00	3.17	.47	.86	.07	0	0	15.00
22-year mean													16.35

Record of precipitation at Rumsey, Yolo County.

[Latitude, 38° 51′; longitude, 122° 14′; elevation, — feet. Authority, Pacific Railway System.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1888-89	0.80	0	6.55	5.15	0.95	1.35	8.20	1.40	2.45	0.15	0	0	27.00
1889-90	0	7.90	4.13	12.07	12.01	4.52	5.32	1.17	1.29	0	0	0	48.41
1890-91	.35	0	0	3.91	.87	13.60	1.16	1.92	1.28	0	0	0	23.09
1891-92	.85	0	.35	4.98	3.49	2.84	3.02	1.21	2.78	0	0	0	19.52
1892-93	0	1.03	10.57	11.37	4.80	5.42	5.77	1.76	.77	0	0	0	41.49
5-year mean													31.90

Record of precipitation at Colgate, Yuba County.

[Latitude, 39° 22′; longitude, 121° 10′; elevation, 650 feet.[a] Authority, Bay Counties Power Company.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1900-1901	0	6.79	7.45	0	6.98	5.07	2.11	0	0.08	0	0	0	28.48
1901-2	1.48	3.61	4.39	5.31	1.44	18.22	4.23	4.10	.80	0	0	0	43.58
2-year mean													36.03

[a] Gage at bottom of canyon 1,000 feet deep.

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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1902

BY

F. H. NEWELL

PART I.—NORTHERN ATLANTIC COAST AND ST. LAWRENCE RIVER DRAINAGE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1903

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF HYDROGRAPHY,
Washington, D. C., February 18, 1903.

SIR: I have the honor to transmit herewith the first number of a series of four papers descriptive of the results of the hydrographic measurements made during the year 1902. These papers will contain the data which heretofore have been published in our Water-Supply Papers under the title of Operations at River Stations, and in the Report of Progress of Stream Measurements, which report until 1901 made up Part IV of the Annual Report. The data usually found in Part IV of the Annual Report were in 1901 published in Water-Supply Paper No. 75. These papers present briefly the original data as collected by the various resident hydrographers, together with the computations and results which have been based upon these facts.

This paper contains the data collected at the stations located in that portion of the Atlantic coast drainage north of and including the James River Basin. Part II will contain the data for the remainder of the stations east of the Mississippi, and Parts III and IV the data for the stations located west of the Mississippi.

Very respectfully,

F. H. NEWELL,
Hydrographer in Charge.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1902.

PART I.

By F. H. Newell.

INTRODUCTION.

The determinations of the water supply of various parts of the United States have been continued during the year 1902 by the Division of Hydrography in a manner similar to that of previous years, slight modifications and improvements having been introduced in methods and operations. The work consists in measuring the streams and estimating the water supply, both above and under ground. To give full facts concerning the water supply it is necessary not merely to ascertain the quantity, but also in many cases the quality, and especially the possibilities of water storage or conservation. Water can not be considered as a resource unless it can be had when needed, and therefore the determination of the practicability of holding the floods until time of drought underlies any statement of water supply. In a similar way when considering underground waters it is not enough to know that there is water beneath the surface, but the facts must be ascertained as to the depth to the water, the rate of movement, if any, and the possibility of bringing the water to the surface at reasonable cost.

The principal operation of the hydrographic surveys, as at present conducted, is that of measuring the waters flowing upon the surface, obtaining their fluctuations in quantity, and sometimes in quality, from month to month and from year to year.

During 1902 the number of stations at which stream measurements were made was steadily increased. This is largely the result of the constant demand for the data collected by the Survey. The requests for information have been so great that the supply of publications has become practically exhausted, necessitating the reprinting in condensed form of the data collected in various localities.

The Survey has received the hearty cooperation of various individuals, corporations, and States, as mentioned hereafter. This cooperation has made possible the publication of many valuable records which could not otherwise have been obtained.

A brief historical sketch of the stream measurements made by the Geological Survey is published on pages 11 to 15 of Water-Supply Paper No. 75.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following Survey publications, which may be consulted at the public libraries in all the large cities:

1893.} Bulletin No. 131.
1894.}

1895. Bulletin No. 140.

1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.

1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.

1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.

1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.

1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.

1901. Water-Supply Papers Nos. 65, 66, and 75.

1902. Water-Supply Papers Nos. 82 to 85, inclusive.

ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is due to each of these persons, and thanks are extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged geographically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Maine.—Resident hydrographer, N. C. Grover, professor of civil engineering, University of Maine, Orono, Me., assisted by F. E. Pressey. Acknowledgment should also be made to the Bangor and Aroostook Railroad and to the Somerset Railroad, for annual passes issued to N. C. Grover; to the Maine Central Railroad, for a pass between April 1 and October 1; to the Portland and Rumford Falls Railroad, for trip passes issued when desired. Thanks are due the following individuals and corporations for data furnished and assistance rendered: A. C. Mixer, engineer of the Rumford Falls Power Company, for records of flow of the Androscoggin at Rumford Falls; Messrs. S. D. Warren & Co., of Westbrook, Me., for records of the flow of the Presumpscot; Alexander H. Twombley, engineer of the Forest Paper Company, of Yarmouthville, Me., for records of the flow of the Cobbosseecontee; Hollingsworth and Whitney Company, of Winslow, Me., for records from which the flow of the Kennebec at Waterville has been computed; and H. S. Ferguson, engineer of the Great Northern Paper Company, of Millinocket, Me., for records from which the flow of the Penobscot at Millinocket has been computed.

New Hampshire.—C. A. Holden, professor of civil engineering, Thayer School, Hanover, N. H., for measurements of the Connecticut River at Orford, N. H.

Massachusetts.—Frederic P. Stearns, chief engineer, and C. W. Sherman, division engineer of the Metropolitan Water Board of Boston, for records of the flow

of Sudbury and Nashua rivers and of Lake Cochituate; R. A. Hale, principal assistant engineer, Essex County, for records of the flow of Merrimac River at Lawrence, Mass., and Capt. Harry Taylor, U. S. Army, Boston, Mass.

Connecticut.—Edwin D. Graves, chief engineer Connecticut River Bridge and Highway District, for the gage heights of Connecticut River near Hartford, Conn., and Greenwich Water Company of Greenwich, Conn.

Rhode Island.—John E. Hill, professor of civil engineering at Brown University, Providence, R. I., for records of the flow of Blackstone River and canal at Berkeley, R. I.

New York.—Resident hydrographer, Robt. E. Horton, assisted by C. C. Covert and F. H. Tillinghast. Special acknowledgment is made to Edward A. Bond, State engineer and surveyor, for his hearty cooperation and assistance in the work. Thanks are due the following persons for data furnished and assistance rendered: Wm. S. Bacot, engineer and general manager of the Consolidated Water Company, Utica, N. Y.; Stephen E. Babcock, C. E., Little Falls, N. Y.; City Water Department, Oswego, N. Y.; Frank E. Hinds, C. E., Watertown, N. Y.; Wm. G. Raymond, C. E., Troy, N. Y.; Hannawa Falls Water Power Company, at Hannawa Falls, N. Y.; Utica Gas and Electric Company, Utica, N. Y.; International Paper Company, Fort Edwards, N. Y.; Duncan Company, Mechanicville, N. Y.; Honk Fall Power Company, Ellensville, N. Y.; Fishkill and Matteawan Water Company, Fishkill on the Hudson, N. Y.; Binghamton Railway Company, Binghamton, N. Y.; S. E. Moore, C. E., Binghamton, N. Y.; O. C. Breed, C. E., Fulton, N. Y.; and E. A. Fisher, C. E., Rochester, N. Y.

New Jersey.—Resident hydrographers, G. B. Hollister and E. G. Paul.

Pennsylvania.—Resident hydrographer, E. G. Paul. Thanks are due to the following persons, who have rendered assistance and furnished data: Mansfield Merriman, professor of civil engineering at Lehigh University, South Bethlehem, Pa.; E. Mather, president of the Harrisburg water commission, Harrisburg, Pa.; John E. Codman, hydrographer for the city water board, Philadelphia, Pa.; and F. A. Snyder, city engineer, Williamsport, Pa.

Maryland.—Resident hydrographer, E. G. Paul.

Virginia and West Virginia.—Resident hydrographers, E. G. Paul and D. C. Humphreys, professor of civil engineering at Washington and Lee University, Lexington, Va.

Acknowledgments are also due to John C. Hoyt, George L. Warner, and H. G. Stokes for computations on and the arrangement of the data in this report; also to H. A. Pressey for assistance in both field and office.

WATER POWERS IN MAINE.

The rivers of the State of Maine furnish some of the best water-power sites in the United States. The large rivers have their sources in general at high elevations among the mountains and hills of the central and northern part of the State. Their fall is rapid, with frequent vertical drops over granite ledges. Building stone is abundant in nearly all the drainage basins. The rocky beds furnish excellent foundations for dams and mills, and the excellent harbors along the coast, together with the railroad lines following the lower courses of the streams, give for a large part of the State excellent transportation facilities. The extensive lake areas, aggregating 2,300 square miles, furnish natural reservoirs for the storage of storm

waters that could not be equaled throughout the United States. In addition to the lakes, the extensive forests covering the greater part of the State and the gravelly and porous soil tend to make the flow of the Maine rivers remarkably uniform.

During the summer of 1901 the United States Geological Survey commenced the hydrographic study of the State of Maine. Prior to that time records of flow from a few of the main rivers had been furnished by engineers and manufacturing companies and published in the reports of the Survey. It is hoped that these records may be continued and that the investigations may be extended, so that definite information may be obtained of the flow, fall, and the possibilities of increased storage on all of the larger streams of the State.

In the following pages the records of flow for the year 1902 are published for all stations for which such figures are available. In addition to these, gage heights are given at a number of the new stations established by the Survey, with the results of current-meter measurements made from time to time. As soon as these stations have been continued for a sufficient period to permit of the construction of rating curves for the stations, the records of flow for each day of the year will be published.

Twelve gaging stations are now being maintained by the Geological Survey in the State of Maine. These stations are under the charge of N. C. Grover, professor of civil engineering, University of Maine, assisted by F. E. Pressey. The stations are located as follows: On the Androscoggin River at Dixfield; on the Kennebec River at The Forks and North Anson; on the Carrabassett River near North Anson; on the Dead River near The Forks; on the Moose River near Rockwood; on the Roach River at Roach River; on the East Branch of the Penobscot at Grindstone; on the Penobscot at Montague; on the Mattawamkeag at Mattawamkeag; on the Piscataquis at Low's bridge, between Foxcroft and Guilford; and on the St. Croix at Spragues Falls.

Aside from the records at these stations, records are also received from various engineers, as noted in the following pages.

A full description of the drainage areas of the Maine rivers will be found in Water-Supply and Irrigation Paper No. 69, and records of flow for past years will be found in the same paper.

ST. CROIX RIVER DRAINAGE BASIN.

St. Croix River is formed by two branches, known as the Upper St. Croix or Chiputneticook River, the outlet of the Schoodic Lakes, and Kennebasis River, the outlet of the western lakes of the area, known as the Kennebasis Lakes. The Upper St. Croix, with its tributary lakes, forms nearly half of the eastern boundary of Maine, separating that State from New Brunswick. The total drainage area of the main stream is about 1,630 square miles, of which 960 square miles are tributary to the great reservoir systems controlled by dams at

Vanceboro and Princeton. The length of the stream from the headwaters to the mouth is 100 miles. The basin is, in general, lower than that of any of the larger streams of the State flowing into the Atlantic, its headwaters having an elevation of about 540 feet. The fall from Chiputneticook Lake (the lower of the Schoodic Lakes) to tide water, a distance of 54 miles, is, however, 382 feet, or 7 feet to the mile, and there are a number of places where falls and rapids occur at which water power has been or can easily be developed.

The lake system of the St. Croix is the largest in the State in proportion to the drainage basin, except that of the Presumpscot, and as the lakes act as a regulator of flow and can easily be improved for greater duty, St. Croix River may be considered one of the best water-power streams on the Atlantic coast. The lake system of the Upper St. Croix comprises approximately 50 square miles of lake surface, and that of the West Branch 70 square miles, considering only the principal lakes and ponds. Indeed, above Vanceboro and Princeton each branch of the river is simply a succession of lakes to almost the extreme headwaters. Wells estimated the total lake surface of the St. Croix as not less than 150 square miles, or nearly one-tenth of the total drainage area. The drainage area at various points on the river is given in the following table:

Drainage area of St. Croix River.

	Sq. miles.
Main river:	
Vanceboro dam, foot of the Schoodic Lakes	420
Little Falls	500
Immediately above mouth of West Branch	690
Immediately below mouth of West Branch	1,360
Spragues Falls	1,390
Calais, lower dam	1,530
Mouth of river, eastern border of town of Calais	1,630
West Branch:	
Princeton dam	500
Confluence with main river	670

A large proportion of the drainage basin is still covered with timber, and above Vanceboro and Princeton the region is for the most part wild and inaccessible, being visited only by lumbermen and sportsmen. The greater part of the timber in this region is controlled by sawmill owners at Calais and St. Stephen. In 1898 the amount of lumber sawed annually had fallen from about 100,000,000 feet to 25,000,000 feet, and since then the number of sawmills has been greatly reduced. In 1901 the lumber sawed amounted to 28,000,000 feet, showing that the rate of cutting has remained nearly constant during the last few years. There are on this stream favorable locations for paper and pulp mills, but arrangements would have to be made with the sawmill owners in order to obtain a supply of timber.

The river is navigable as far as Calais, except during two months of the year, when it is frozen. Calais has railroad connection with

Bangor directly over the Washington County Railroad, and, by way of Vanceboro, over the Canadian Pacific and the Maine Central railroads. There is also a short road connecting Princeton with Calais. Above Princeton the transportation facilities are poor. Calais, Princeton, and Vanceboro, in Maine, and St. Stephen, in New Brunswick, are towns with populations of from 1,000 to 10,000, largely engaged in the manufacture of lumber.

ST. CROIX RIVER AT SPRAGUES FALLS, NEAR BARING, ME.

This station was established December 4, 1902, by F. E. Pressey. The drainage area at this point is 1,390 square miles. The usual form of wire gage is attached to the lower guard timber of the Washington County Railroad Bridge. It is referenced by a bench mark on the down-stream corner of bridge seat on right abutment; elevation 17.60 feet above zero of gage. The gage is read daily by Simeon Phinney, section foreman on the Washington County Railroad, who resides in Baring, Me. The measurements of flow are made from a car suspended on a steel cable, which is stretched over the river about one-half mile above the bridge. The channel is straight 100 feet above and 1,000 feet below the cable. The banks are high and rocky, and the bed is rocky. The station is best reached by carriage from Calais, Me., because trains run so infrequently on this branch of the Washington County Railroad.

Daily gage height, in feet, of St. Croix River, at Spragues Falls, near Baring, Me., for December, 1902.

Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.
4	6.9	11	8.4	18	9.0	25	9.0
5	7.1	12	8.6	19	9.1	26	8.9
6	7.2	13	8.7	20	8.8	27	8.8
7	7.4	14	9.0	21	8.8	28	8.5
8	7.8	15	9.7	22	8.7	29	8.2
9	8.0	16	9.7	23	8.9	30	8.0
10	8.3	17	8.5	24	9.1	31	8.0

PENOBSCOT RIVER DRAINAGE BASIN.

The Penobscot has the largest drainage basin of all the rivers in Maine, comprising about 8,500 square miles, or more than one-quarter of the entire State. Its greatest length from north to south is 160 miles, its greatest width 115 miles, all within the State. Eight hundred square miles of the basin discharge their waters into the main river below its lowest water power at Bangor.

The basin is at a lower elevation above the sea than the basins of the Kennebec and the Androscoggin, as would be expected from the general southeasterly slope of the country toward the Atlantic Ocean. The northern portion, however, is rather elevated, having a mean

height of about 1,000 feet. The highest portion of the basin is at the headwaters of the main river, where the elevation is from 1,600 to 2,000 feet.

Taken as a whole, the basin is rather uniform in its topographic features. Hills and low mountains stretch from near the sea to above Bangor; farther north is an undulating plain, while to the west the surface becomes more broken and greatly diversified by hills, detached peaks, lakes, ponds, and swamps. At the south the basin merges into that of the Kennebec, and at the north into that of the Alleguash, terminating on the northwest, at the boundaries of the State, in a highland region intermingled with swamps and lagoons, the latter furnishing water to the Penobscot and the St. John. A large part of the basin is what is known as "wild land," being heavily timbered and known only to the lumberman and the sportsman. Few regions in the country are more delightful to the lover of nature than the forests, the lakes, and the mountains on the headwaters of the Penobscot. From Mount Katahdin, the highest mountain of the State, a view can be obtained in all directions, overlooking the extensive plain and showing vast stretches of forests dotted here and there with lakes.

Over the upper portion of the basin slate is the principal surface rock, being succeeded to the east and south by schists, gneiss, and granite; the soil is mainly gravel, clay, and loam.

The drainage areas of the river and its chief tributaries are given in the following table:

Drainage areas of Penobscot River and principal tributaries.[a]

River.	Locality.	Drainage area.
		Square miles.
Penobscot	Opposite northwest extremity of Moosehead Lake, township of Seboomook, immediately below mouth of Nulhedus Creek.	510
Do	Entrance into Chesuncook Lake	850
Do	Outlet of Chesuncook Lake	1,450
Do	Millinocket, outlet of Twin Lakes	1,880
Do	Immediately below mouth of east branch of Penobscot.[a]	3,260
Do	Immediately below mouth of Mattawamkeag.[a]	4,940
Do	Montague, immediately below mouth of Piscataquis.[a]	6,630
Do	Sunk Haze Rips[a]	7,260
Do	Old Town, above mouth of Pushaw River[a]	7,340
Do	Bangor, above mouth of Kenduskeag River[a]	7,720

[a] Includes Chamberlain Lake Basin (270 square miles).

Drainage areas of Penobscot River and principal tributaries—Continued.

River.	Locality.	Drainage area.
		Square miles.
Penobscot	Mouth [a]	8,550
Cauquomogomoc	Entrance into Chesuncook Lake	230
East branch of Penobscot.	Grindstone [a]	1,130
Do	Mouth [a]	1,160
Mattawamkeag	Immediately below outlet of Baskahegan Lake.	190
Do	Mouth	1,510
Piscataquis	Low's bridge	280
Do	Dover	330
Do	Mouth	1,500
Passadumkeag	do	400

[a] Includes Chamberlain Lake basin (270 square miles).

The river naturally has a comparatively uniform flow throughout the year, which is due to the extent of the tributary area, its extensive system of lakes, the vast breadth of forests upon its drainage surfaces, and the more uniform surface of the basin, in which particular it has decided advantage over the Saco, the Androscoggin, and the Kennebec.

PENOBSCOT RIVER AT MONTAGUE, ME.

A gaging station was established by N. C. Grover at Montague on November 5, 1901. The station is located at the highway bridge across the Penobscot, about 1,000 feet below the mouth of the Piscataquis River. The drainage area at this point is 6,630 square miles, of which 270 square miles is the area of Chamberlain Lake, which flows into the Penobscot only part of the year. The measurements are made from the bridge. A wire gage of the usual type is fastened to the guard timber on the upper side of the bridge. It is graduated to feet and tenths and is referred to a bench mark, the top of the northwest corner of second course below bridge seat, easterly abutment, the elevation being 25.78 feet above zero of the gage. The initial point of soundings is at the extreme end of the inclined end post on upstream side of bridge. The channel is straight for 1,000 feet above and 3,000 feet below the station, and the current is swift. The banks are high and rocky, and the bed rocky, with some gravel. The gage is read twice daily—7 a. m. and 5 p. m.—by A. H. Hanson, a merchant in Montague.

Discharge measurements of Penobscot River at Montague, Me.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Second-feet.*
November 5	F. E. Pressey	2.00	3,034
1902.			
March 28	do	12.90	57,427
April 8	do	11.00	43,937
July 15	N. C. Grover	5.30	11,271
August 28	F. E. Pressey	4.00	7,575
September 15	do	4.10	7,773
October 11	R. M. Connor	3.95	7,446

Daily gage height, in feet, of Penobscot River at Montague, Me.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	5.30	5.15	(a)	14.60	9.30	6.35	7.60	5.45	2.35	3.10	7.00	4.30
2	4.05	5.15	.....	14.05	10.75	6.20	7.50	5.35	2.95	3.20	6.10	4.25
3	4.45	5.35	.....	13.45	10.30	6.25	7.55	5.15	3.10	3.05	5.40	3.90
4	4.60	5.20	.....	12.90	10.05	7.55	7.60	5.00	3.45	3.05	5.15	3.55
5	4.40	5.05	.....	12.35	9.80	9.30	7.50	5.25	3.30	2.95	5.25	3.90
6	4.20	5.00	.....	11.50	9.60	10.15	7.15	5.20	3.20	2.75	5.00	3.80
7	4.15	4.90	.....	11.15	9.50	10.25	6.75	5.10	3.15	3.30	4.55	3.70
8	3.70	4.80	.....	10.95	9.40	10.10	6.30	5.20	2.90	3.90	4.35	5.00
9	3.75	(a)	.....	10.75	9.30	12.00	6.25	5.30	2.45	4.15	4.15	(a)
10	3.60	.....	.....	10.90	9.10	12.30	6.05	5.15	3.10	4.05	3.90	.....
11	3.10	.....	.....	11.15	8.75	11.55	5.80	5.00	3.65	3.85	4.05	.....
12	3.00	.....	.....	11.25	8.40	11.00	5.25	5.40	3.85	3.30	4.10	.....
13	2.90	.....	.....	11.15	8.10	10.50	5.40	6.25	3.65	3.25	4.15	.....
14	2.95	.....	.....	10.80	7.70	10.10	6.15	6.45	3.75	3.05	4.20	.....
15	2.80	.....	.....	10.45	7.35	9.70	5.30	6.60	4.00	3.30	4.30	.....
16	2.70	.....	.....	10.40	7.00	9.15	4.80	5.00	3.85	3.15	4.40	.....
17	2.55	.....	.....	10.25	6.70	8.50	4.90	5.15	3.70	3.20	4.25	.....
18	2.30	.....	.....	10.05	6.70	8.15	4.95	5.00	3.60	3.15	4.30	.....
19	2.55	.....	.....	9.55	6.60	7.75	5.10	5.40	3.50	3.00	4.45	.....
20	2.30	.....	.....	8.75	6.35	7.15	5.25	6.25	3.35	2.95	4.40	.....
21	2.65	.....	.....	8.85	6.05	6.50	5.90	5.95	3.35	3.50	4.30	.....
22	2.70	.....	.....	9.10	6.25	6.45	6.10	6.60	3.40	4.10	4.30	.....
23	3.90	.....	.....	9.00	6.45	7.70	5.85	5.00	3.35	3.90	4.30	.....
24	6.30	.....	.....	8.90	6.80	7.60	4.95	4.35	3.30	3.50	4.05	.....
25	6.65	.....	.....	9.00	6.80	7.25	4.70	3.60	3.25	3.25	4.05	.....
26	5.65	.....	.....	9.10	6.95	7.20	4.80	3.70	3.20	3.05	4.25	.....
27	5.85	.....	.....	9.15	6.85	9.55	4.55	3.95	3.10	3.05	4.00	.....
28	6.20	.....	12.80	9.35	6.80	9.85	5.05	4.00	2.95	3.90	4.05	.....
29	6.35	.....	12.80	9.35	7.10	8.65	5.85	3.70	2.80	7.90	4.05	.....
30	5.65	.....	14.55	9.30	7.05	8.05	5.90	3.45	2.95	8.20	4.40	.....
31	5.75	.....	15.10	.....	6.70	.....	5.80	2.95	.....	7.60	.....	.....

[a] Frozen February 5 to March 27 and December 9 to 31.

Rating table for Penobscot River at Montague, Me., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.0	3,034	5.4	11,715	8.8	28,206	12.2	52,325
2.2	3,502	5.6	12,299	9.0	29,605	12.4	53,745
2.4	3,970	5.8	13,015	9.2	31,025	12.6	55,165
2.6	4,438	6.0	13,763	9.4	32,445	12.8	56,585
2.8	4,906	6.2	14,543	9.6	33,865	13.0	58,005
3.0	5,374	6.4	15,355	9.8	35,285	13.2	59,425
3.2	5,842	6.6	16,199	10.0	36,705	13.4	60,845
3.4	6,310	6.8	17,075	10.2	38,125	13.6	62,265
3.6	6,778	7.0	17,985	10.4	39,545	13.8	63,685
3.8	7,246	7.2	18,925	10.6	40,965	14.0	65,105
4.0	7,714	7.4	19,897	10.8	42,385	14.2	66,525
4.2	8,193	7.6	20,901	11.0	43,805	14.4	67,945
4.4	8,701	7.8	21,940	11.2	45,225	14.6	69,365
4.6	9,241	8.0	23,050	11.4	46,645	14.8	70,785
4.8	9,813	8.2	24,240	11.6	48,065	15.0	72,205
5.0	10,417	8.4	25,510	11.8	49,485		
5.2	11,053	8.6	26,842	12.0	50,905		

Estimated monthly discharge of Penobscot River at Montague, Me.

[Drainage area, 6,630 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
November 5 to 30	----------	----------	[a] 3,466	[a] 0.52	[a] 0.50
December	68,655	3,034	14,583	2.20	2.54
1902.					
January	16,415	3,736	8,354	1.26	1.45
February 1 to 8 [b]	----------	----------	[a] 10,662	[a] 1.61	[a] 0.48
March 28 to 31 [b]	----------	----------	[a] 63,774	[a] 9.62	[a] 1.43
April	69,365	27,862	40,862	6.16	6.87
May	42,030	13,955	23,694	3.57	4.12
June	53,035	14,543	29,024	4.38	4.88
July	20,901	9,103	13,737	2.07	2.39
August	16,199	5,257	10,788	1.63	1.88
September	7,714	3,853	6,037	0.91	1.02
October	24,240	4,789	7,787	1.17	1.35
November	17,985	7,480	9,149	1.38	1.54
December 1 to 8 [b]	----------	----------	[a] 7,882	[a] 1.19	[a] 0.35

[a] Partial month.

[b] River frozen for remainder of the month.

PENOBSCOT RIVER AT MILLINOCKET, ME.

The discharge of the Penobscot at Millinocket since January 11, 1901, has been computed from data furnished by H. S. Ferguson, engineer for the Great Northern Paper Company. These results were obtained by adding to the flow through the wheels the flow over the dam. The wheels were rated at Holyoke, Mass., before being placed in position. As the head under which they work, averaging about 110 feet, is much greater than the head under which they were tested, several tube float measurements of the flow in the canal leading to the mill have been made by Mr. Ferguson in order to determine just how much water the mill uses under different conditions of gate openings. By means of these measurements it is believed that a very good estimate has been made of the flow through the wheels. The dam is of concrete, resting on ledge, and does not leak. The flow over it was computed by use of the formula $Q=c\ b\ H^{\frac{3}{2}}$, in which c is a variable coefficient obtained from a study of the results of experiments made by George W. Rafter at the Cornell testing flume.

The area of the drainage basin at Millinocket is 1,880 square miles. The following tables give the record of flow for the years 1901 and 1902:

Mean daily flow, in second-feet, of Penobscot River at Millinocket, Me.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	.....	1,580	1,740	1,710	20,220	2,580	2,580	1,800	2,310	2,000	760	410
2	.....	1,670	1,510	1,370	19,360	2,680	2,490	1,980	3,600	1,960	690	470
3	.....	2,250	1,450	1,680	18,030	2,760	2,680	1,690	3,280	1,960	570	470
4	.....	1,410	1,680	2,000	17,240	2,440	3,310	2,830	2,130	1,950	710	460
5	.....	1,840	1,930	1,920	16,280	2,550	1,540	1,760	1,940	1,540	760	450
6	.....	1,630	1,510	2,180	15,030	2,430	1,930	2,000	1,930	1,740	700	440
7	.....	1,210	1,410	2,800	14,000	2,550	2,420	1,910	1,810	1,990	510	430
8	.....	1,660	1,300	3,210	9,240	2,680	2,710	2,850	3,750	1,940	490	420
9	.....	1,910	1,160	4,890	6,130	2,540	2,390	3,960	3,110	1,960	330	860
10	.....	1,480	1,470	4,420	5,280	2,770	2,600	3,930	1,940	1,950	1,090	840
11	1,310	1,050	1,930	5,430	3,410	2,770	2,450	6,500	1,880	1,600	1,020	850
12	960	1,740	1,510	6,030	2,740	2,480	2,630	6,440	1,970	1,240	760	450
13	1,200	2,360	1,510	5,920	2,790	2,780	3,450	2,030	1,940	980	630	450
14	1,500	1,890	1,720	6,400	2,930	2,960	2,830	1,940	1,820	1,530	1,230	470
15	1,460	1,860	1,510	8,610	3,130	3,200	6,790	2,060	3,860	1,320	760	780
16	1,310	2,000	2,030	8,880	3,320	3,370	3,820	2,200	3,880	1,250	750	1,760
17	1,260	1,230	1,450	9,860	4,130	3,370	4,010	1,980	1,950	1,130	380	1,520
18	1,430	1,650	1,610	12,390	3,830	2,350	3,520	2,910	3,010	1,470	790	1,530
19	1,450	1,440	1,770	12,320	4,650	2,240	7,600	2,160	3,980	1,650	720	1,890
20	1,390	1,550	1,830	14,020	4,750	2,450	8,140	2,040	3,360	1,420	440	1,720
21	1,500	1,390	1,410	15,770	3,250	2,390	3,850	2,040	3,150	1,020	450	1,800
22	1,780	1,760	1,370	17,230	2,260	2,360	6,880	1,990	4,470	990	450	1,880
23	1,000	1,450	1,420	19,210	2,010	2,570	3,310	1,970	4,050	1,120	360	1,710
24	1,700	1,600	1,480	11,360	1,520	2,400	2,270	1,980	1,930	790	390	1,710
25	1,410	1,640	1,780	10,410	1,780	2,800	2,380	2,020	1,910	1,060	400	990
26	2,060	1,330	1,910	10,650	1,890	2,710	2,120	4,880	1,920	1,010	450	1,900
27	1,560	1,420	1,510	20,040	3,440	2,560	2,860	2,700	1,960	610	860	1,810
28	1,590	1,600	1,940	22,110	2,690	2,280	2,260	1,910	1,830	840	980	1,700
29	1,390	.....	1,940	20,360	2,980	2,760	6,250	1,950	1,360	730	450	1,760
30	1,170	.....	1,990	20,240	2,570	2,860	6,250	1,790	1,960	750	810	2,000
31	1,600	.....	1,350	.....	3,050	.....	3,240	1,910	.....	780	.....	1,960

Mean daily flow, in second-feet, of Penobscot River at Millinocket, Me.—Continued.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902												
1	2,230	1,930	2,140	13,150	11,180	4,130	3,040	2,520	2,300	2,140	2,240	5,140
2	2,860	2,630	2,110	14,110	11,180	2,890	2,820	2,520	2,640	2,030	2,090	2,620
3	2,160	2,180	2,110	13,820	11,190	5,430	2,580	1,570	2,160	2,070	4,860	2,360
4	2,160	2,090	2,110	13,380	11,070	6,300	460	2,540	2,540	2,090	2,410	2,370
5	2,130	2,110	2,110	14,050	11,420	11,600	330	2,440	2,190	2,330	2,410	2,390
6	2,010	2,040	2,100	14,050	12,600	11,600	1,420	2,540	2,150	2,540	2,530	2,130
7	2,040	2,100	2,180	15,030	12,580	12,440	2,560	2,560	1,790	2,410	2,580	2,010
8	2,010	1,940	2,340	14,120	15,030	17,240	2,570	2,510	2,420	2,200	2,220	5,390
9	2,020	3,440	2,350	13,240	13,380	20,040	2,570	2,980	2,180	2,250	2,220	2,950
10	1,950	2,120	2,530	13,180	12,960	19,370	2,560	2,820	2,420	2,290	2,510	2,570
11	1,740	2,020	2,320	13,170	14,840	20,590	2,560	2,250	2,380	2,140	2,470	2,400
12	2,030	2,000	2,820	13,070	12,140	20,230	2,560	2,450	2,170	1,940	2,480	2,440
13	2,030	2,060	2,820	13,340	12,150	17,510	2,380	2,430	2,070	2,110	2,090	2,340
14	2,030	1,970	2,700	13,210	10,470	15,590	2,550	2,410	1,780	2,450	2,520	2,420
15	2,020	1,870	2,690	12,310	16,920	11,860	2,570	2,500	2,100	2,150	2,440	4,390
16	2,190	3,090	2,500	12,400	6,350	11,600	2,550	2,430	2,110	2,770	2,540	2,530
17	2,030	3,370	5,500	12,390	6,220	10,870	2,560	2,010	2,520	2,420	2,650	2,510
18	1,910	2,060	5,390	12,010	9,590	10,980	2,560	2,220	2,110	2,640	2,570	2,480
19	2,560	2,110	6,430	6,770	9,050	7,710	2,540	2,260	2,070	2,330	2,500	2,600
20	1,980	2,120	6,960	8,380	7,680	9,560	2,290	4,380	2,060	2,460	2,540	2,520
21	1,950	2,130	8,760	9,030	5,880	3,210	2,550	4,330	1,910	2,180	2,410	2,190
22	1,970	2,020	8,580	7,840	8,820	3,930	2,550	4,310	2,120	2,490	2,390	3,970
23	2,070	3,440	8,190	7,940	8,920	3,930	2,550	3,870	2,080	2,170	1,350	2,440
24	1,960	2,110	9,950	7,950	8,800	3,570	2,560	1,890	2,120	2,160	2,700	1,960
25	2,080	2,120	9,910	9,740	6,220	3,290	2,550	2,480	2,130	2,170	2,440	570
26	2,660	2,130	9,790	10,180	5,940	3,290	2,530	2,280	2,140	1,960	2,450	3,490
27	1,950	2,140	9,820	11,330	8,260	3,270	2,370	2,460	2,110	2,150	2,440	2,470
28	1,800	2,120	9,790	11,740	3,090	3,900	2,560	2,410	1,870	2,570	2,500	2,230
29	3,270	.....	9,840	11,190	3,120	2,970	2,800	2,330	2,090	2,590	2,410	2,200
30	2,170	.....	9,970	11,200	3,110	2,870	2,590	2,450	2,480	2,160	1,440	2,150
31	2,160	.....	9,970	.....	3,110	.....	2,700	1,930	.....	2,520	.....	2,160

Estimated monthly discharge of Penobscot River at Millinocket, Me.

[Drainage area, 1,880 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
January 11 to 31	2,060	960	1,430	0.76	0.88
February	2,360	1,050	1,629	.87	.91
March	2,030	1,160	1,617	.86	.99
April	22,110	1,370	9,447	5.02	5.60
May	20,220	1,520	6,578	3.50	4.04
June	3,370	2,240	2,654	1.41	1.57
July	8,140	1,540	3,599	1.91	2.20
August	6,500	1,690	2,584	1.37	1.58
September	4,470	1,360	2,600	1.38	1.54
October	2,000	610	1,364	.73	.84
November	1,230	330	656	.35	.39
December	2,000	410	1,158	.62	.71
The year	22,110	330	2,943	1.56	21.25
1902.					
January	3,270	1,740	2,133	1.13	1.30
February	3,440	1,870	2,266	1.21	1.26
March	9,970	2,100	5,380	2.86	3.30
April	15,030	6,770	11,777	6.26	6.98
May	16,920	3,090	9,460	5.03	5.80
June	20,590	2,870	9,392	5.00	5.58
July	3,040	330	2,398	1.28	1.48
August	4,380	1,570	2,615	1.39	1.60
September	2,640	1,780	2,174	1.16	1.29
October	2,770	1,940	2,287	1.22	1.41
November	4,860	1,350	2,447	1.30	1.45
December	5,390	570	2,658	1.41	1.63
The year	20,590	330	4,582	2.44	33.08

EAST BRANCH OF PENOBSCOT RIVER AT GRINDSTONE, ME.

This station was established October 23, 1902, by F. E. Pressey. I is located at the Bangor and Aroostook Railroad bridge, one-half mil south of the hotel. The measurements are made from the railroa bridge. The drainage area at this point is 1,130 square miles, includ ing the Chamberlain Lake basin (270 square miles). The initial poin for soundings is on the left bank, at the lower end of the inclined en post. The gage is of the usual wire type, and the scale board, gradu ated to feet and tenths, is nailed to the guard timber on the uppe side of the bridge. The gage is read daily, at 7 a. m. and 5. p. m., b L. B. Trask. The channel both above and below this station i straight. The bed of the stream is rocky, and the stream is confine in the channel by the abutments of the bridge. The bench mark i located on the east abutment, at the southwest corner of the bridg seat. Elevation, 26.32 feet above the zero of the gage. During 190 the following measurements were made by F. E. Pressey:

October 23: Gage height, 5.15 feet; discharge, 706 second-feet.
November 26: Gage height, 5.41 feet; discharge, 921 second-feet.

Daily gage height, in feet, of East Branch of Penobscot River at Grindstone, Me for 1902.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec
1		6.15	5.50	12		5.65	5.30	23	5.15	5.60	
2		6.05	5.50	13		5.80	5.30	24	5.10	5.60	
3		5.90	5.40	14		5.55	(a)	25	5.10	5.55	
4		5.90	5.20	15		5.50		26	5.10	5.50	
5		5.90	5.20	16		5.50		27	5.10	5.60	
6		5.80	5.30	17		5.70		28	5.50	5.70	
7		5.80	5.30	18		5.60		29	7.65	5.55	
8		5.70	5.30	19		5.55		30	7.05	5.50	
9		5.65	5.30	20		5.50		31	6.45		
10		5.70	5.30	21		5.55					
11		5.60	5.30	22		5.60					

[a] Frozen from December 14 to 31.

MATTAWAMKEAG RIVER AT MATTAWAMKEAG, ME.

This station was established August 26, 1902, by F. E. Pressey. I is located at the Maine Central Railroad bridge over the Mattawan keag River in the town of Mattawamkeag. The area of the drainag basin at this point is 1,510 square miles. The initial point for sound ings is on the left bank, at the south end of the bridge, at the lower en of the inclined end post. The gage is of the usual wire type, and th scale board, which is graduated to feet and tenths, is nailed to th guard timber of the lower side of the bridge. The gage is read at a. m. and 4 p. m. by Leon D. Mincher. The channel both above an below this station is straight, and the bed of the stream is rocky an

the water is confined to the channel by the abutments of the bridge. The bench mark is on the north abutment at the southwest corner of the bridge seat. Its elevation is 26.78 feet above the zero of the gage.

The following discharge measurements were made during 1902 by F. E. Pressey:

July 31: Gage height, 4.4 feet; discharge, 1,318 second-feet.
August 27: Gage height, 4.7 feet; discharge, 1,847 second-feet.
September 16: Gage height, 5.0 feet; discharge, 1,970 second-feet.
November 8: Gage height, 5.89 feet; discharge, 3,556 second-feet.

Daily gage height, in feet, of Mattawamkeag River at Mattawamkeag, Me., for 1902.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.10	4.60	7.85	5.65	17		5.00	4.80	5.50	7.00
2		4.05	4.60	7.40	5.45	18		4.90	4.80	5.50	7.45
3		4.40	4.60	7.00	5.45	19		4.85	4.80	5.50	7.80
4		4.70	4.55	6.65	5.25	20		4.70	4.85	5.50	(a)
5		4.60	4.40	6.35	5.35	21		4.50	5.05	5.40	
6		4.60	4.45	6.10	5.30	22		4.40	5.20	5.50	
7		4.50	4.75	6.00	5.35	23		4.40	5.15	5.50	
8		4.40	5.25	5.90	7.25	24		4.40	5.00	5.50	
9		4.30	5.45	5.75	7.05	25		4.35	4.85	5.50	
10		4.45	5.40	5.65	6.70	26	4.60	4.40	4.70	5.45	
11		4.50	5.20	5.45	6.45	27	4.70	4.40	4.65	5.35	
12		4.60	5.10	5.30	6.40	28	4.60	4.25	5.05	5.40	
13		4.70	4.95	5.25	(a)	29	4.50	4.30	6.80	5.55	
14		4.80	4.90	5.20		30	4.40	4.35	7.80	5.70	
15		4.80	4.80	5.30		31	4.25		8.00		
16		5.00	4.80	5.40							

a Frozen December 13 to 16 and 20 to 31.

PISCATAQUIS RIVER AT LOW'S BRIDGE, NEAR FOXCROFT, ME.

This station was established August 17, 1902, by F. E. Pressey. It is located at Low's bridge, about half way between Guilford and Foxcroft, Me. The area of the drainage basin at this point is 280 square miles. The initial point for soundings is on the left bank, at the stream side edge of the top stone of the left abutment. The gage is a painted staff, graduated to feet and tenths, spiked to the left abutment. It is read at 7 a. m. and 5 p. m. by A. F. D. Harlow. The channel both above and below the station is straight, the banks are high and gravelly, and the bed is rocky. The bench mark is on the left abutment, at the top of the second course from the top. Elevation, 17.8 feet above the zero of the gage.

The following discharge measurements were made during 1902 by F. E. Pressey:

August 13: Gage height, 3.7 feet; discharge, 998 second-feet.
August 16: Gage height, 2.8 feet; discharge, 332 second-feet.
September 10: Gage height, 2.75 feet; discharge, 288 second-feet.
October 18: Gage height, 2.0 feet; discharge, 61 second-feet.

Daily gage height, in feet, of Piscataquis River at Low's bridge, near Foxcroft, Me., for 1902.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.45	2.65	3.90	3.05	17	2.45	3.15	2.60	3.50	(a)
2		2.35	2.65	3.55	3.00	18	2.75	2.85	2.25	3.35	.....
3		2.40	2.55	3.50	2.90	19	2.55	2.75	2.00	3.05	.....
4		2.40	2.45	3.50	2.80	20	2.50	2.75	2.90	3.25	.....
5		2.50	2.40	3.30	2.70	21	2.85	2.70	3.35	3.25	.....
6		2.40	2.30	3.35	(a)	22	2.65	2.65	3.10	3.15	.....
7		2.35	2.90	3.10	.....	23	2.40	2.55	2.95	3.05	.....
8		2.55	3.15	3.15	.....	24	2.35	2.70	2.95	3.05	.....
9		2.55	3.10	3.00	.....	25	2.65	2.60	2.90	3.00	.....
10		3.30	2.95	3.10	.....	26	2.70	2.60	2.70	3.00	.....
11		3.60	2.75	2.90	.....	27	2.75	2.55	2.75	2.80	.....
12		3.25	2.50	3.25	.....	28	2.70	2.20	4.00	3.05	.....
13		2.45	2.70	3.85	.....	29	2.50	2.35	6.25	3.00	.....
14		2.70	2.35	3.50	.....	30	2.45	2.65	5.10	2.95	.....
15		2.95	2.10	3.40	.....	31	1.75	.....	4.25	.....	.....
16		3.15	2.15	3.30	.....						

a Frozen December 6 to 31.

Rating table for Piscataquis River at Low's bridge, near Foxcroft, Me., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.0	60	2.6	230	3.2	595	3.8	1,075
2.1	75	2.7	270	3.3	675	3.9	1,155
2.2	100	2.8	320	3.4	755	4.0	1,235
2.3	125	2.9	380	3.5	835	.....	.....
2.4	160	3.0	445	3.6	915	.....	.....
2.5	195	3.1	515	3.7	995	.....	.....

Estimated monthly discharge of Piscataquis River at Low's bridge, near Foxcroft, Me.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
August 17 to 31	.....	.....	218	0.78	0.44
September	1,155	100	299	1.07	1.19
October	3,035	60	506	1.81	2.09
November	1,155	320	638	2.28	2.54
December 1 to 5	480	270	379	1.35	.25

KENNEBEC RIVER DRAINAGE BASIN.

Kennebec River is one of the best streams in the United States for the development of water power. Its basin lies between those of the Androscoggin and the Penobscot and extends from the Canada line to the ocean. The basin measures 150 miles in length and varies in width from 50 to 80 miles in the main portion, embracing a total area of 6,110 square miles. Of this area, 1,330 square miles are tributary to Moosehead Lake.

The river rises in Moosehead Lake, though its headwaters are collected by Moose River, Roach River, and a number of smaller streams rising in the hilly, forested areas lying to the east and west of that lake. The northern part of the drainage basin is broken by offsets from the White Mountains. Nearly the whole of the upper portion of the drainage area is forest covered and in its original wild state. Below the outlet of Moosehead Lake the hills close in upon the river, forming a narrow, rocky chasm, with steep and precipitous sides. From Moosehead Lake to The Forks the river is a torrent, falling over a rocky bed 500 feet in a distance of 23 miles. At The Forks the waters of Dead River, which rises near the western boundary of the State at an elevation of about 2,000 feet, are joined to the main stream. Below this junction the river flows through a broad vay'le, with gentle slopes upon either side, still covered to some extent with forest growth, but largely cleared and with occasional cultivated farms. About 60 miles from the coast the hills again rise, though not to a considerable height. There are on the river a number of large falls, which have been developed by the construction of dams and are now used for sawmills, pulp mills, and cotton mills.

The prevailing rock in the northern part of the basin is slate, with a belt of sandstone to the west and a district of granite to the east of Moosehead. South of Bingham mica-schists run into the clay slate in spots and elsewhere into gneiss, but (except where broken by intrusions of granite, as at Hallowell and Augusta) the slate prevails as far as Gardiner. Below the latter city gneiss predominates, with stretches of mica-schists on the east bank. The surface materials are finely pulverized, and water-retaining sands and gravels are more abundant in the northern part, succeeded by a greater proportion of loam and clay to the south.

The areas of the drainage basins of the river and its principal tributaries are given in the following table:

Drainage areas of Kennebec River and principal tributaries.

River.	Locality.	Drainage area.
		Square miles.
Kennebec	Outlet of Moosehead Lake	1,330
Do	The Forks	1,670
Do	Immediately below mouth of Dead River	2,540
Do	Carritunk Falls, Solon	2,790
Do	North Anson, above mouth of Carrabassett River.	2,880
Do	Madison	3,310
Do	Norridgewock	4,020
Do	Fairfield	4,370
Do	Waterville, above mouth of Sebasticook River.	4,380
Do	Waterville, below mouth of Sebasticook River.	5,310
Do	Augusta	5,710
Do	Head of Merrymeeting Bay	6,110
Moose	Mouth	680
Roach	Roach River	85
Dead	Mouth, The Forks	870
Carrabassett	North Anson, above Embden Brook	340
Sandy	Farmington	350
Do	Mouth	670
Sebasticook	do	930
Messalonskee	do	220
Cobbosseecontee	do	240

The United States Geological Survey now maintains gaging stations at the following places on the Kennebec drainage: On the Kennebec at The Forks and at North Anson, on the Carrabassett River at North Anson, on Dead River at The Forks, on Moose River at Rockwood, and on Roach River at Roach River.

Since 1892 records have been kept at Waterville by the Hollingsworth & Whitney Pulp and Paper Company. Records for the years 1901 and 1902 are published in this report.

KENNEBEC RIVER AT THE FORKS, ME.

This station was established by N. C. Grover, September 28, 1901, at the bridge across the Kennebec River at The Forks. The gage is a vertical rod, graduated to feet and tenths, and referred to a bench mark which is the top of a bolt on east abutment, north side of bridge; the elevation of the bench mark is 12.85 feet above the zero of the gage. The initial point of soundings is on the left bank, marked by a rod across the bridge, just above the abutment and below

the bridge floor. The channel is straight above the station for about 200 feet and below for a distance of 500 feet. The current is swift, the banks high and rocky, with a rocky and permanent stream bed. The gage is read twice daily, 7 a. m. and 5 p. m., by William W. Young. The drainage area of the Kennebec River at this point is 1,670 square miles. The following measurements of flow of the Kennebec at this point have been made by N. C. Grover and F. E. Pressey:

Discharge measurements of Kennebec River at The Forks, Me.

Date.	Hydrographer.	Gage height.	Discharge.
1901.		*Feet.*	*Sec.-ft.*
September 28	N. C. Grover	2.60	1,863
October 20	do	.90	473
1902.			
April 25	do	3.70	3,495
June 16	do	5.60	8,862
June 25	do	4.75	5,896
September 14	F. E. Pressey	2.10	1,475

Daily gage height, in feet, of Kennebec River at The Forks, Me.

Day.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.										
1	(a)	8.60	6.85	4.10	6.00	4.50	1.95	2.05	1.10	(b)
2	2.55	8.40	8.05	5.75	6.15	4.50	1.95	1.80	1.10	
3	2.90	8.10	8.20	6.35	6.10	5.65	1.95	1.60	1.10	
4	3.10	7.95	8.20	6.50	6.00	4.05	2.40	2.00	1.45	
5	3.00	7.55	6.40	7.55	5.80	4.05	2.35	2.05	1.30	
6	2.95	7.15	6.05	7.80	5.80	3.80	2.60	2.00	1.45	
7	2.70	6.40	6.25	7.50	5.40	3.50	2.55	2.05	1.50	
8	2.85	6.60	6.25	7.60	4.80	3.40	2.65	2.05	1.50	
9	2.70	6.50	6.70	7.70	4.75	3.40	2.70	2.00	2.00	
10	2.60	6.45	6.35	7.80	4.50	3.40	2.65	1.80	2.00	
11	2.60	6.30	6.70	6.70	4.55	3.50	2.60	1.60	2.00	
12	2.00	5.35	6.80	6.40	4.50	3.50	2.55	1.60	2.10	
13	1.60	5.50	6.70	6.10	5.80	3.30	2.50	1.95	2.05	
14	1.60	5.30	7.10	5.80	4.95	3.35	2.45	2.00	2.10	
15	1.50	5.25	6.90	7.30	4.65	3.15	2.40	2.05	2.00	
16	1.45	5.10	5.50	5.70	4.75	3.00	2.30	2.20	(b)	
17	2.00	5.60	5.75	5.55	4.65	3.05	2.10	2.20		
18	2.55	5.70	5.30	5.45	4.65	3.00	2.00	1.60		
19	2.90	5.90	5.50	5.90	4.65	2.95	2.00	2.00		3.00
20	3.80	5.85	4.50	5.90	4.65	2.75	2.00	2.10		3.00
21	4.00	6.10	4.90	4.70	4.65	2.85	2.50	2.50		3.00
22	4.30	6.25	4.90	5.50	4.50	2.80	2.80	2.35		3.00
23	4.40	5.80	4.80	5.15	5.20	2.80	2.50	2.55		3.00
24	4.30	5.05	5.00	5.20	3.80	2.80	2.05	2.45		3.00
25	3.85	4.20	5.60	6.10	2.70	2.80	2.45	2.60		3.00
26	3.50	3.75	6.50	5.30	2.90	2.60	2.00	2.40		3.00
27	3.60	4.80	6.50	5.55	3.15	2.20	2.25	2.40		3.00
28	4.00	6.05	4.50	4.45	4.25	2.00	2.15	2.55		(a)
29	4.35	6.10	4.00	4.30	4.15	2.00	2.10	2.55		
30	6.00	6.00	3.75	4.80	4.15	2.00	2.15	2.50		
31	7.80		4.60		4.30	2.10		1.80		

[a] Frozen from January 1 to March 1 and December 28 to 31.
[b] No measurements, November 16 to December 18.

Rating table for Kennebec River at The Forks, Me., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.0	560	3.2	2,635	5.4	8,000	7.6	16,800
1.2	720	3.4	2,950	5.6	8,800	7.8	17,600
1.4	880	3.6	3,310	5.8	9,600	8.0	18,400
1.6	1,040	3.8	3,700	6.0	10,400	8.5	20,400
1.8	1,200	4.0	4,120	6.2	11,200	9.0	22,400
2.0	1,365	4.2	4,560	6.4	12,000	9.5	24,400
2.2	1,525	4.4	5,020	6.6	12,800	10.0	26,400
2.4	1,700	4.6	5,510	6.8	13,600	10.5	28,400
2.6	1,900	4.8	6,040	7.0	14,400	11.0	30,400
2.8	2,105	5.0	6,620	7.2	15,200	11.5	32,400
3.0	2,350	5.2	7,270	7.4	16,000	12.0	34,400

Estimated monthly discharge of Kennebec River at The Forks, Me.

[Drainage area, 1,670 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
October	2,350	480	1,585	0.95	1.10
November	1,900	1,120	1,442	0.86	0.96
December 8 to 19			[b] 8,498	[b] 5.09	[b] 2.27
1902.					
March [a]	17,600	920	3,336	2.00	2.31
April	20,800	3,600	11,109	6.65	7.42
May	19,200	3,600	10,531	6.31	7.29
June	17,600	4,330	10,628	6.36	7.09
July	11,000	2,000	6,285	3.76	4.34
August	9,000	1,365	2,875	1.72	1.98
September	2,105	1,325	1,651	0.99	1.10
October	1,900	1,040	1,461	0.87	1.00
November 1 to 15	1,445	640	[b] 1,082	[b] 0.65	[b] 0.31
December 19 to 27	2,350	2,350	[b] 2,350	[b] 1.41	[b] 0.51

[a] Frozen during January and February. [b] Partial month.

KENNEBEC RIVER AT NORTH ANSON, ME.

This station was established on October 18, 1901, by N. C. Grover. It is located 1½ miles east of North Anson, and is reached by private conveyance. Measurements are made from the bridge across the

Kennebec. The gage is a vertical rod graduated to feet and tenths and fastened to the bridge pier. It is referred to two bench marks, one being the top of pier back of gage, elevation 22.5 feet, and the other the top of the southeast corner of the twelfth stone from the top of west abutment, elevation 9.55 feet above the zero of the gage. The initial point of soundings is on the left bank at the outside of the end post of the bridge. The channel is straight above the station for 500 feet, and below for 1,000 feet. The current is swift, the right bank high and rocky, while the left bank is comparatively low and subject to overflow at the time of highest water. The bed of the stream is rocky, with sand over a portion of the section. The gage is read twice daily, at 8 a. m. and 4 p. m., by C. S. Benjamin, the toll collector at the bridge. The drainage area is 2,880 square miles. The following measurements have been made by N. C. Grover and F. E. Pressey:

October 14, 1901: Gage height, 3.2 feet; discharge, 3,114 second-feet.
October 18, 1901: Gage height, 3.0 feet; discharge, 2,458 second-feet.
July 29, 1902: Gage height, 4.55 feet; discharge, 6,224 second-feet.

Daily gage height, in feet, of Kennebec River at North Anson, Me.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.										
1	(a)	12.65	10.75	6.95	6.10	4.10	3.25	3.15	5.10	3.25
2		11.70	10.45	6.70	5.85	4.50	3.35	3.25	3.95	3.40
3		10.75	11.30	6.10	5.85	5.30	3.15	3.00	3.50	3.50
4		9.00	9.90	7.40	5.60	4.85	3.00	2.95	3.25	3.45
5		7.90	7.55	8.75	5.45	4.50	3.45	2.90	3.10	3.35
6		7.00	7.25	8.90	5.35	4.15	3.35	3.10	3.15	(a)
7		7.15	7.55	8.95	5.05	4.20	3.20	3.25	3.10	
8		7.20	8.60	8.60	5.00	4.15	3.45	3.45	3.05	
9		7.45	8.15	9.90	4.80	4.25	3.35	3.30	3.05	
10		7.00	7.90	9.25	4.85	4.20	3.75	2.90	3.20	
11		6.90	6.45	8.30	5.00	4.20	3.95	2.80	3.05	
12		6.85	7.45	7.65	5.00	4.40	3.65	2.65	2.95	
13		6.75	6.95	6.70	5.05	4.15	3.40	2.90	3.20	
14		6.30	6.95	6.45	4.90	3.70	3.80	3.05	3.35	
15		6.50	5.95	6.30	4.90	3.60	4.10	3.15	3.60	
16		6.85	5.80	6.10	5.05	3.65	3.95	3.40	3.85	
17		6.75	5.75	6.20	5.10	3.20	3.50	3.20	4.05	
18		6.05	5.75	6.25	5.20	3.00	3.10	3.10	4.10	
19		6.80	5.35	5.65	5.10	2.55	3.05	3.05	4.00	
20		6.35	5.15	5.55	5.30	2.70	3.25	3.70	3.85	
21		7.35	5.35	5.20	5.55	3.20	4.00	3.65	3.85	
22		7.15	5.55	5.65	5.55	3.15	4.25	3.95	3.85	
23	11.30	7.55	5.80	5.55	5.25	3.80	4.00	3.90	3.70	
24	8.75	7.30	5.90	6.10	5.25	4.15	3.90	3.65	3.80	
25	7.75	6.30	5.80	5.65	5.05	4.15	3.30	3.50	3.65	
26	6.75	6.55	6.65	6.75	5.05	3.65	3.00	3.00	3.45	
27	6.05	6.55	7.65	7.45	5.00	3.25	3.00	2.95	3.40	
28	5.75	6.85	8.25	6.60	4.65	3.15	3.05	3.65	3.15	
29	7.55	7.10	9.25	5.95	4.40	3.00	3.20	5.95	3.15	
30	11.60	7.65	7.55	5.70	4.45	2.85	3.15	5.85	3.15	
31	11.35		7.30		4.25	2.95		5.80		

[a] Frozen January 1 to March 22 and December 6 to 31.

KENNEBEC RIVER AT WATERVILLE, ME.

The only long-continued observations of the volume of the river are those which have been made at Waterville by the Hollingsworth & Whitney Company, which kindly furnished the results for publication herein. The works of that company are above the mouth of Sebasticook River. The tributary drainage area of the Kennebec at that point is about 4,380 square miles. The figures really represent the flow at 12 o'clock noon of each day, that hour having been chosen, after investigation, as a time when the flow is least affected by storage at dams upstream, and as giving most nearly the average for the day.

A summary of these results, including 1900, will be found in Water-Supply Paper, No. 69. The following tables give the results for 1901 and 1902:

Daily discharge, in second-feet, of Kennebec River at Waterville, Me.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	3,740	2,990	2,050	11,600	29,600	5,140	9,080	6,480	1,470	2,770	3,710	170
2	3,530	2,920	2,270	15,260	30,570	6,540	8,350	5,270	4,760	2,160	3,080	2,580
3	3,240	2,180	1,620	19,580	29,620	8,700	8,330	4,810	4,270	1,590	480	2,630
4	2,990	2,690	2,840	25,040	28,080	12,930	4,020	2,410	3,910	2,140	3,020	2,310
5	2,420	2,680	4,080	54,490	23,350	11,380	7,940	3,890	3,640	2,730	3,630	2,540
6	1,880	2,670	4,290	57,960	21,380	9,990	7,330	3,170	3,630	960	3,090	2,410
7	3,100	2,700	4,350	42,370	13,300	9,110	5,110	3,290	3,040	3,090	3,370	1,990
8	3,280	3,000	4,220	76,410	11,800	9,930	5,130	5,820	1,140	2,460	2,810	230
9	3,220	2,420	4,130	76,590	13,290	15,250	6,020	6,180	2,870	2,740	2,530	2,480
10	3,040	2,000	2,870	60,700	12,340	13,900	5,770	5,640	3,120	2,390	560	2,470
11	3,240	2,680	4,090	53,410	16,330	10,000	5,750	3,240	2,790	2,470	2,620	3,080
12	3,240	2,690	4,010	39,290	22,880	10,120	5,450	5,640	3,070	2,380	2,210	4,060
13	2,780	2,690	3,970	35,610	23,110	7,830	5,440	5,920	3,650	670	2,220	4,220
14	3,230	2,660	4,060	33,250	21,770	7,830	3,310	5,410	3,700	3,050	2,930	4,220
15	2,940	2,340	3,390	31,460	18,120	7,470	4,860	5,010	1,700	6,430	1,640	10,300
16	3,430	2,350	3,410	30,220	14,230	5,660	4,600	3,840	3,370	6,680	2,270	15,100
17	3,530	2,000	3,080	29,300	14,210	7,840	4,450	5,640	3,090	5,060	1,260	46,750
18	3,960	2,900	3,700	28,820	12,110	6,640	4,400	4,630	2,830	4,360	2,830	29,730
19	4,010	2,640	3,440	29,150	10,450	7,170	4,450	4,700	1,910	4,230	2,530	19,870
20	2,840	2,650	3,110	27,600	14,560	6,630	4,840	4,060	2,800	1,870	2,570	11,770
21	3,250	2,670	3,640	28,540	11,930	6,290	4,010	3,900	2,560	2,810	2,590	6,380
22	3,490	2,380	4,180	45,590	7,560	6,420	4,220	3,650	750	2,830	2,330	5,230
23	3,500	2,390	5,050	65,770	9,860	5,620	3,940	3,120	3,160	2,340	2,270	3,980
24	3,520	1,430	700	65,970	7,600	6,960	3,480	3,800	3,190	2,920	1,470	6,480
25	3,230	2,140	8,510	49,700	7,590	6,020	3,400	3,530	2,800	2,960	2,810	8,110
26	3,260	2,320	8,500	44,710	6,620	6,880	3,720	4,100	2,810	3,720	2,200	7,520
27	2,380	2,530	12,890	42,510	9,090	6,970	3,810	3,900	2,420	1,280	2,330	7,100
28	2,990	1,990	10,530	39,950	8,260	7,050	2,810	2,880	2,380	3,100	2,090	6,360
29	3,260	.....	13,340	38,280	9,060	6,980	4,510	1,890	790	2,840	2,260	3,740
30	2,950		8,440	34,780	5,140	7,800	4,520	1,840	3,010	2,790	2,430	4,600
31	2,970	.....	4,120	.....	6,420	.....	5,740	1,850	.....	2,850	.....	4,920

Daily discharge, in second-feet, of Kennebec River at Waterville, Me.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	4,610	4,020	11,790	47,870	34,410	15,370	12,200	4,990	3,190	4,090	8,020	4,100
2	4,280	2,670	23,180	37,920	28,840	15,350	12,670	5,370	4,120	4,120	5,980	4,080
3	3,960	4,100	35,110	36,530	28,890	13,050	13,200	4,630	4,060	4,110	5,670	4,090
4	3,150	3,840	54,340	29,290	26,340	12,500	10,310	9,010	3,280	4,080	4,830	4,070
5	900	3,850	38,650	25,220	19,740	17,860	10,930	7,480	3,740	2,020	3,760	3,390
6	3,460	3,980	30,250	19,460	17,210	19,750	9,890	6,490	4,090	3,510	4,130	4,070
7	3,730	4,010	25,920	21,340	17,860	19,140	10,470	5,320	1,580	4,170	4,220	1,020
8	3,490	4,010	22,280	21,260	24,290	16,830	9,850	5,130	3,500	5,550	4,080	3,710
9	2,960	2,850	20,240	20,020	20,720	26,140	8,880	5,240	4,040	4,160	3,040	3,190
10	3,260	3,990	17,740	24,790	17,520	24,550	8,910	4,420	4,000	4,160	4,120	3,580
11	3,760	3,970	20,940	23,370	15,730	20,390	9,510	5,090	7,540	3,770	4,090	2,900
12	2,240	3,910	13,160	23,470	13,030	16,510	9,410	5,730	5,850	1,750	4,100	4,090
13	3,840	3,910	14,230	21,340	13,490	14,760	7,260	5,850	5,390	3,510	4,020	3,990
14	3,410	3,940	17,590	21,290	13,600	13,040	5,440	5,180	3,430	3,780	4,180	2,350
15	2,890	3,950	18,940	16,970	10,480	11,700	6,940	3,860	7,570	3,730	4,380	3,990
16	3,210	2,100	18,860	18,730	10,530	11,210	7,340	3,980	5,860	4,060	4,550	3,970
17	3,180	3,950	27,940	17,540	9,720	11,340	7,200	1,890	5,180	4,120	5,450	6,930
18	3,160	3,370	46,630	16,940	8,410	11,590	6,920	3,740	4,140	4,080	5,420	5,150
19	1,790	3,930	22,400	17,500	5,560	10,670	6,940	3,440	4,100	2,060	5,040	5,480
20	3,550	3,660	27,320	17,880	8,420	10,550	5,740	2,640	4,100	4,200	4,920	4,900
21	2,870	3,440	46,570	18,740	9,640	9,710	6,780	2,300	2,410	4,980	4,680	3,420
22	2,860	3,660	45,320	21,250	8,950	8,400	7,010	3,320	4,730	4,510	4,380	4,710
23	7,810	3,150	46,670	24,030	12,320	13,110	6,940	5,950	4,530	4,560	4,470	6,220
24	10,510	4,080	36,990	21,290	8,990	10,620	6,460	12,670	4,180	4,200	4,600	6,900
25	6,360	4,100	27,490	17,640	13,030	10,160	6,230	8,250	3,990	4,130	4,160	5,460
26	4,620	4,840	22,900	13,910	13,560	10,200	4,870	6,590	3,820	2,730	4,300	5,160
27	4,070	4,420	18,720	13,430	21,690	33,940	4,500	4,030	4,020	3,950	3,450	5,150
28	3,870	4,700	13,920	18,620	23,800	21,870	5,100	4,130	2,060	7,830	4,200	4,660
29	3,880	.....	20,670	19,500	29,210	15,370	5,170	4,150	3,950	24,980	4,140	5,000
30	3,910	.....	57,970	18,600	19,250	12,130	4,950	4,040	4,100	15,170	3,130	4,540
31	3,940	.....	47,070	.....	17,820	.....	4,950	1,860	.....	10,830	.....	4,450

Estimated monthly discharge of Kennebec River at Waterville, Me.

[Drainage area, 4,380 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
January	4,040	1,880	3,176	0.73	0.84
February	3,000	1,430	2,489	.57	.59
March	13,340	700	4,805	1.10	1.27
April	76,590	11,600	41,130	9.39	10.47
May	30,570	5,140	15,169	3.46	3.99
June	15,250	5,140	8,235	1.88	2.10
July	9,080	2,810	5,122	1.17	1.35
August	6,480	1,840	4,178	.95	1.10

Estimated monthly discharge of Kennebec River at Waterville, Me.—Continued.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
September	4,760	750	2,821	.64	.71
October	6,680	670	2,925	.67	.77
November	3,710	480	2,405	.55	.61
December	46,750	170	7,527	1.72	1.98
The year	76,590	170	8,332	1.90	25.78
1902.					
January	10,510	900	3,856	.88	1.01
February	4,840	2,100	3,800	.87	.91
March	57,970	11,790	28,768	6.57	7.57
April	47,870	13,430	22,191	5.07	5.66
May	34,410	5,560	16,873	3.85	4.44
June	33,940	8,400	15,260	3.48	3.88
July	13,200	4,500	7,840	1.79	2.06
August	12,670	1,860	5,057	1.15	1.3[illegible]
September	7,570	1,580	4,218	.96	1.07
October	24,980	1,750	5,255	1.20	1.3[illegible]
November	8,020	3,040	4,517	1.03	1.1[illegible]
December	6,930	1,020	4,346	.99	1.1[illegible]
The year	57,970	900	10,165	2.32	31.6[illegible]

CARRABASSETT RIVER NEAR NORTH ANSON, ME.

This river enters the Kennebec from the west at North Anson. It basin has steep slopes, partly in farm lands, with no large natura reservoirs. Dams have been constructed and power used at New Portland, East New Portland, and North Anson. On October 19 1901, a gaging station was established on the Carrabassett, 4 mile west of North Anson, by N. C. Grover. The station is located abov Embden Brook and below Anson Brook. The drainage area is 34 square miles at this point. The gaging is made from a boat held i position by a manila rope stretched across the stream. The gage i a vertical rod graduated to feet and tenths, and referred to a benc mark on a blazed spruce tree 40 feet from the gage. The elevatio of bench mark is 10.78 feet above the zero of the gage. The gage read every morning by N. Q. Hilton, a farmer in North Anson, Me

Discharge measurements of Carrabassett River near North Anson, Me.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Sec.-ft.*
June 27	N. C. Grover	4.3	4,168
July 30	F. E. Pressey	0.6	192
October 30	do	2.48	1,812
Do	do	2.68	2,120
October 31	do	2.00	1,369
November 1	do	1.69	1,129
Do	do	1.60	1,083
November 2	do	1.42	882
November 3	do	1.35	851

Daily gage height, in feet, of Carrabassett River near North Anson, Me.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.							
1		1.40	0.40	0.70	0.90	1.70	1.00
2		1.80	.40	.80	1.10	1.50	1.00
3		1.60	1.50	.70	1.00	1.40	.90
4		1.50	1.20	.70	.90	1.30	1.00
5		1.30	1.00	.90	.80	1.20	1.10
6		1.10	.90	.80	1.20	1.10	1.10
7		1.00	.80	.70	1.70	1.10	1.20
8		.90	.80	.90	1.30	1.10	1.20
9		.80	.80	.80	1.10	1.10	1.10
10		.80	.80	2.80	1.10	1.00	1.10
11		.90	.70	1.90	1.00	1.00	1.10
12		.70	.90	1.40	.90	1.00	.90
13		.70	.90	1.20	.90	1.10	1.10
14		.60	.70	2.80	.90	1.10	[a]
15		.60	.60	2.10	1.00	1.40	
16		.60	.50	1.60	.90	1.50	
17		.60	.50	1.30	.80	1.50	
18		.50	.50	1.10	.80	1.30	
19		.50	.50	1.00	.80	1.20	
20		.60	.30	1.40	1.40	1.20	
21		.60	.30	1.10	1.60	1.20	
22		1.00	.30	1.10	1.30	1.10	
23		1.00	6.40	1.00	1.10	1.20	
24		.80	3.60	1.10	1.10	1.10	
25		.80	2.30	.90	.90	1.10	
26	4.80	.70	1.60	.80	1.00	1.00	
27	4.90	.60	1.40	.80	.90	1.00	
28	3.10	.60	1.10	.80	1.50	1.10	
29	2.20	.60	1.00	1.00	4.30	1.00	
30	1.70	.50	.80	1.00	2.50	1.00	
31		.50	.70		2.00		

[a] Frozen December 14 to 31.

Rating table for Carrabassett River near North Anson, Me., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.4	70	1.8	1,235	3.2	2,665	4.6	4,565
.6	192	2.0	1,400	3.4	2,935	4.8	4,840
.8	365	2.2	1,575	3.6	3,210	5.0	5,100
1.0	540	2.4	1,750	3.8	3,480		
1.2	715	2.6	1,950	4.0	3,755		
1.4	885	2.8	2,160	4.2	4,030		
1.6	1,060	3.0	2,400	4.4	4,300		

Estimated monthly discharge of Carrabassett River near North Anson, Me.

[Drainage area, 340 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
June 26 to 30			[b]3,012	[b]8.86	[b]1.67
July	1,235	130	408	1.20	1.38
August	6,920	45	713	2.10	2.42
September	2,160	275	716	2.11	2.35
October	1,850	365	763	2.24	2.58
November	1,145	540	703	2.07	2.31
December 1 to 13 [a]	715	450	[b]595	[b]1.75	[b].85

[a] Gage frozen remainder of month.

[b] Partial month.

DEAD RIVER NEAR THE FORKS, ME.

This tributary of the Kennebec has its headwaters in the mountains between Maine and Canada and flows in a general easterly direction, entering the Kennebec at The Forks. Its basin contains 870 square miles and is 40 miles in extreme length by 30 in width and almost wholly wooded. Through a large portion of its length the river flows through swamps; in its lower course it has considerable fall. The only dams on the stream are owned by the log-driving companies, and the gates are kept open after the drive is out of the river. A gaging station was established on Dead River near The Forks on September 29, 1901, by N. C. Grover. The station is 1½ miles west of The Forks, and is reached by private conveyance. The measurements are made from a car suspended from a steel cable. There are two gages, one on either bank. The gage on the right bank is a vertical rod grad-

uated to feet and tenths and referred to two bench marks. One is on the right bank on the top of large bowlder at end of wharf on which gage is placed; its elevation is 4.48 feet above the zero of the gage. The other is on the left bank, 200 feet above the gage, on the top of bowlder; its elevation is 10.89 feet. The gage on the left bank is an inclined rod graduated to feet and tenths of vertical elevation, and referred to one bench mark marked by a cross on a granite bowlder near the gage; its elevation is 5.55 feet above the zero of the gage. The channel is straight for 500 feet above and below the cable, the current swift. The banks are rocky, though subject to overflow at the time of highest water. The bed is rocky and permanent. The gage is read twice daily, 6 a. m. and 6 p. m., by Jeremiah Durgin, jr., a farmer at The Forks.

The following discharge me surement was made during the year 1901 by N. C. Grover:

September 29; Gage height, 0.40 foot; discharge, 225 second-feet.

Daily gage height, in feet, of Dead River near The Forks, Me.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.							
1		2.57	2.35	0.80	1.00	2.40	1.00
2		2.10	2.25	.90	1.00	1.85	1.00
3		1.85	2.20	1.00	.90	1.75	1.20
4		1.55	1.95	1.10	.90	1.75	1.20
5		1.70	1.80	1.15	1.00	1.55	1.10
6		1.50	1.60	1.00	.90	1.45	1.00
7		1.40	1.50	1.10	1.15	1.35	(a)
8		1.40	1.40	1.00	1.25	1.30	
9		1.30	1.40	.90	1.55	1.25	
10		1.10	1.35	1.00	1.50	1.10	
11		1.00	1.25	1.10	1.20	1.00	
12		.80	1.10	1.45	1.25	1.40	
13		1.20	1.00	1.75	1.45	1.80	
14		1.15	.90	1.80	1.60	1.90	1.10
15		1.10	.80	1.70	1.60	1.85	1.20
16		1.10	.70	1.60	1.60	1.70	1.20
17		1.10	1.10	1.50	2.00	1.90	1.10
18		1.10	1.00	1.35	1.50	1.80	1.10
19		1.10	1.00	1.60		1.80	1.20
20		1.00	1.00	1.75	1.00	1.65	1.20
21		.85	.90	1.75	1.00	1.55	1.30
22		.70	.80	1.80	.90	1.50	1.45
23		.70	.70	1.70	.90	1.50	1.50
24		.90	1.00	1.55	1.00	1.40	1.50
25	1.60	1.00	1.80	1.35	1.10	1.30	1.50
26	2.00	1.10	1.50	1.20	1.15	1.30	1.50
27	3.30	1.20	1.30	1.10	1.10	1.20	1.40
28	3.20	1.45	1.20	1.10	1.20	1.10	(a)
29	4.15	1.65	1.10	1.10	1.00	1.05	
30	3.20	2.00	1.00	1.00	1.50	1.00	
31		2.10	.90		1.85		

a Frozen December 7 to 13 and 28 to 31.

MOOSE RIVER NEAR ROCKWOOD, ME.

This station was established September 7, 1902, by N. C. Grover. It is located 4 miles west of Kineo, Me., 2 miles from the mouth of the river, and is reached by steamer on the lake and rowboat on the river. The drainage basin is 680 square miles at this point. Measurements are made from a car suspended from a steel cable. The initial point for soundings is on the right bank, 1 foot from a birch tree, to which the tag line and cable are attached. The gage is a painted post, graduated to feet and tenths, driven into the clay bed of the river, and braced from several trees. For high-water stages a gage is placed on a fir tree about 20 feet upstream from the low-water gage. The gage is read daily at 7 a. m. and 4 p. m. by Peter Callaghan. The channel, both above and below the station, is straight, the banks are high and rocky, and the bed of the stream is rocky. The bench mark is a horizontal mark on the fir tree behind and on a level with the 10-foot mark of the high-water gage.

During 1902 the following measurements were made by F. E. Pressey:

September 7: Gage height, 2.4 feet; discharge, 385 second-feet.
November 23: Gage height, 3.9 feet; discharge, 1,168 second-feet.

Daily gage height, in feet, of Moose River near Rockwood, Me., for 1902.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		3.60	4.60	3.50	17	3.00	3.30	3.90	2.80
2		3.60	4.60	3.50	18	2.90	3.25	3.90	2.80
3		3.50	4.50	3.50	19	2.90	3.30	3.90	2.80
4		3.45	4.40	3.40	20	3.10	3.40	3.90	2.80
5		3.40	4.35	3.40	21	3.10	3.45	3.90	2.80
6		3.40	4.30	3.40	22	3.40	3.45	3.90	2.85
7	2.40	3.40	4.20	3.35	23	3.70	3.50	3.90	2.90
8	2.40	3.50	4.20	3.25	24	3.80	3.50	3.90	2.90
9	2.40	3.50	4.05	3.15	25	3.80	3.50	3.85	2.65
10	2.50	3.45	4.00	3.10	26	3.80	3.45	3.80	2.70
11	2.50	3.40	3.90	3.00	27	3.80	3.40	3.75	2.90
12	2.60	3.40	3.85	2.95	28	3.75	3.50	3.70	2.90
13	2.60	3.30	3.80	2.90	29	3.70	4.05	3.65	2.90
14	2.75	3.30	3.80	2.90	30	3.70	4.45	3.60	2.90
15	2.85	3.30	3.80	2.80	31		4.60		2.90
16	2.90	3.30	3.80	2.80					

ROACH RIVER AT ROACH RIVER, ME.

This stream, entering Moosehead Lake from the east, rises in the highland region of Maine, its basin being well wooded and containing several ponds of considerable size. At the foot of Lower Roach Pond is a dam, owned by the log drivers, which controls the flow of the river. The drainage area of the river at this point is 85 square miles.

The station at Roach River was established November 10, 1901, by N. C. Grover. It is reached by stage from Lily Bay. The gage is a vertical rod spiked to the timber retaining embankment on the right bank of the stream. It is divided into feet and tenths and referred to a bench mark, a cross on the top timber to which the gage is spiked, the elevation of this mark being 9 feet. The gage is read twice daily, at 9 a. m. and 3 p. m., by C. H. Sawyer, hotel keeper.

During 1902 the following measurements were made by F. E. Pressey:

September 2: Gage height, 2.50 feet; discharge, 112 second-feet.
September 2: Gage height, 2.70 feet; discharge, 200 second-feet.
September 2: Gage height, 2.90 feet; discharge, 286 second-feet.
September 3: Gage height, 2.30 feet; discharge, 72 second-feet.
September 3: Gage height, 2.11 feet; discharge, 32 second-feet.

Daily gage height, in feet, of Roach River at Roach River, Me.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2.80	2.90	2.60	2.30	5.60	2.50	2.80	2.25	2.50	2.30	2.30	2.50
2	2.80	2.80	2.60	2.30	3.80	2.50	2.80	2.50	2.50	2.30	2.50	2.50
3	2.80	2.80	2.85	2.30	5.40	2.50	2.80	2.50	2.50	2.30	2.50	2.50
4	2.60	2.80	3.00	2.30	3.80	2.50	2.80	2.50	2.50	2.30	2.50	2.50
5	2.60	2.80	3.15	3.75	5.40	2.50	2.80	2.50	2.50	2.30	2.50	2.50
6	2.60	2.80	3.20	5.15	3.80	2.50	2.80	2.50	2.50	2.30	2.50	2.50
7	2.90	2.80	3.20	5.10	3.80	2.50	2.80	2.50	2.50	2.30	2.50	2.50
8	2.90	2.80	3.15	2.30	2.20	2.50	2.80	2.50	2.50	2.30	2.50	2.50
9	2.90	2.80	3.00	5.10	5.50	3.00	2.80	2.50	2.50	2.30	2.50	2.50
10	2.90	2.80	3.00	3.75	3.85	3.00	2.80	2.50	2.40	2.30	2.50	2.50
11	2.90	2.80	3.00	5.20	2.20	3.00	2.80	2.50	2.40	2.30	2.50	2.50
12	2.90	2.80	3.00	3.75	5.50	3.00	2.80	2.50	2.40	2.30	2.50	2.50
13	2.90	2.80	3.00	3.75	3.85	3.00	2.80	2.50	2.40	2.30	2.50	2.50
14	2.90	2.80	3.00	5.20	3.85	3.00	2.80	2.50	2.40	2.50	2.50	2.50
15	2.90	2.60	3.00	3.75	2.20	2.60	2.80	2.50	2.40	2.30	2.50	2.50
16	2.90	2.60	3.00	3.75	3.85	2.60	2.80	2.50	2.40	2.30	2.50	2.50
17	2.90	2.60	3.10	5.20	3.85	2.60	2.80	2.50	2.30	2.30	2.50	2.50
18	2.90	3.60	3.40	5.20	2.20	2.60	2.80	2.50	2.30	2.30	2.50	2.50
19	2.90	2.60	3.50	2.30	2.20	2.60	2.80	2.50	2.30	2.30	2.50	2.50
20	2.90	2.60	4.50	3.75	2.20	2.60	2.80	2.50	2.30	2.30	2.50	2.50
21	2.90	2.60	5.35	3.75	3.85	2.60	2.80	2.50	2.30	2.30	2.50	2.50
22	2.90	2.60	4.00	4.90	3.85	2.80	2.80	2.50	2.30	2.30	2.50	2.50
23	3.10	2.60	4.90	4.90	2.20	2.80	2.80	2.50	2.30	2.30	2.50	2.50
24	3.00	2.60	3.95	5.30	5.50	2.80	2.80	2.50	2.30	2.30	2.50	2.50
25	2.90	2.60	4.20	5.25	5.50	2.80	2.80	2.50	2.30	2.30	2.50	2.20
26	2.90	2.60	3.90	5.10	5.50	2.80	2.80	2.50	2.30	2.30	2.50	2.20
27	2.90	2.60	2.70	2.30	5.50	2.80	2.80	2.50	2.30	2.30	2.50	2.20
28	2.90	2.60	2.20	2.30	3.50	2.80	2.80	2.50	2.30	2.30	2.50	2.20
29	2.90	.....	2.25	4.60	3.05	2.80	2.50	2.50	2.30	2.30	2.50	2.20
30	2.90	.....	2.30	4.90	2.60	2.80	2.20	2.50	2.30	2.30	2.50	2.20
31	2.90	.....	2.30	.....	2.60	.....	2.20	2.50	.....	2.30	.....	2.20

Rating table for Roach River at Roach River, Me., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.1	31	2.8	244	3.5	538	4.4	916
2.2	48	2.9	286	3.6	580	4.6	1,000
2.3	67	3.0	328	3.7	622	4.8	1,084
2.4	90	3.1	370	3.8	664	5.0	1,168
2.5	118	3.2	412	3.9	706	5.2	1,252
2.6	156	3.3	454	4.0	748	5.4	1,336
2.7	200	3.4	496	4.2	832	5.6	1,420

Estimated monthly discharge of Roach River at Roach River, Me.

[Drainage area, 85 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
November 10 to 30			53	0.62	0.69
December	601	67	261	3.07	3.54
1902.					
January	370	156	273	3.21	3.70
February	286	156	202	2.38	2.48
March	1,315	48	432	5.08	5.86
April	1,294	67	750	8.82	9.83
May	1,420	48	687	8.08	9.31
June	328	118	207	2.44	2.72
July	244	48	227	2.67	3.08
August	118	57	116	1.36	1.57
September	118	67	88	1.04	1.16
October	67	67	67	.79	.91
November	118	67	116	1.36	1.52
December	118	48	102	1.20	1.38
The year	1,420	48	272	3.20	43.52

COBBOSSEECONTEE RIVER AT GARDINER, ME.

Cobbosseecontee River drains a group of lakes lying from 5 to 15 miles westerly from Augusta, and empties into the Kennebec 6 miles below that city at Gardiner, its drainage area amounting to about 240

square miles. From the ordinary surface of Lake Maranacook, one of the upper lakes, to mean tide at the mouth of the river the fall is 206 feet, and in the lower three-fourths of a mile it is said to be 136 feet. From above the uppermost of the 8 dams controlled by the Gardiner Water Power Company, which are in the latter three-fourths of a mile, the municipal water supply for Gardiner is drawn and pumped by water power. Record is kept of the water pumped and of the water that passes the dam through a waste gate. The sum of these quantities represents the yield of the drainage area at the upper dam, records of which have been kept by the Gardiner Water Power Company for a series of years, and have been furnished to the Survey by their engineer, A. H. Twombly. The record for 1902 is presented in the accompanying table. On Sundays and on legal holidays the gates are closed and no water is permitted to run unless the lakes are full. This is a most remarkable example of the regularity of flow that can be obtained with proper storage.

Mean daily flow, in second-feet, of Cobbosseecontee River at Gardiner, Me.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	500	463	2,400	1,803	713	0	280	280	280	280	270	270
2	348	280	2,400	1,748	713	280	280	280	280	280	0	270
3	294	280	2,222	1,593	650	280	280	0	280	280	270	270
4	280	280	1,702	1,540	566	280	20	280	280	280	270	270
5	0	280	1,583	1,390	514	280	21	280	280	0	270	270
6	280	280	1,370	1,071	465	280	0	280	280	280	270	270
7	280	280	1,165	848	415	280	280	280	0	280	270	0
8	280	280	1,017	280	393	0	280	280	280	280	270	270
9	280	280	878	280	373	280	280	280	280	280	0	270
10	280	280	878	354	306	280	280	0	280	280	270	259
11	280	280	1,065	705	280	280	280	280	280	280	270	250
12	0	280	1,114	819	280	280	280	280	280	0	270	250
13	280	280	1,214	927	280	280	0	280	280	280	270	250
14	280	280	1,267	900	280	280	280	280	0	280	270	0
15	280	280	1,017	705	280	0	280	280	280	280	270	250
16	280	280	746	584	280	280	280	280	280	270	0	250
17	280	280	833	531	280	280	230	0	280	270	270	250
18	280	280	1,423	465	0	280	280	280	280	270	270	250
19	0	280	1,267	438	280	280	280	280	280	0	270	250
20	280	280	1,531	438	280	280	0	280	280	270	270	250
21	280	280	1,765	415	280	280	280	280	0	270	270	0
22	280	280	1,702	369	280	0	280	280	280	270	270	250
23	1,642	280	1,583	369	280	280	280	280	280	270	0	256
24	1,446	280	1,478	345	280	280	280	0	280	270	270	276
25	1,097	280	1,370	313	0	280	280	280	280	270	270	40
26	924	280	1,267	313	280	280	280	280	280	0	270	290
27	752	280	1,165	94	280	280	0	280	280	270	270	264
28	776	280	1,017	367	280	280	280	280	0	270	270	264
29	719	.....	789	367	280	0	280	280	280	270	270	256
30	479	.....	1,531	350	280	280	280	280	280	270	0	250
31	479	.....	1,531	.....	280	.....	280	0	.....	270	.....	250

ANDROSCOGGIN RIVER DRAINAGE BASIN.

Androscoggin River is formed by the junction of Magalloway River and the outlet of the Umbagog-Rangeley lakes near the Maine-New Hampshire boundary line. For about 35 miles it flows southward into the State of New Hampshire, then turns abruptly to the east and flows into the State of Maine, then turns to the south and joins the Kennebec in Merrymeeting Bay. The last fall on the Androscoggin is at Brunswick, Me., above which place the drainage area is 3,470 square miles, about 80 per cent of which is in Maine. The greatest length of the basin is 110 miles, the greatest width 70 miles, while the river itself measures about 200 miles in length from the sources of Magalloway River to the coast. The following table gives the drainage areas of the river at various points, and some of its chief tributaries:

Drainage areas of Androscoggin River and principal tributaries.

River.	Locality.	Drainage area.
		Square miles.
Androscoggin	Immediately below junction of Umbagog outlet and Magalloway River, at Errol Dam.	1,090
Do	Berlin	1,350
Do	Rumford Falls	2,090
Do	Dixfield	2,230
Do	Livermore Falls	2,550
Do	Lewiston Falls	2,950
Do	Brunswick	3,470
Umbagog Outlet	Immediately above junction with Magalloway River	590
Magalloway	Mouth	500
Little Androscoggin	do	380

The lower part of the basin is hilly and moderately wooded, while the upper two-thirds is broken and mountainous, heavily timbered, and with a gravelly, sandy soil. Granite, gneiss, and mica-schists abound along the main course of the river, with clay slate in the upper part of the basin. The river, like others on the southern slopes of Maine, generally has a rocky bed, particularly where falls occur, has high banks, and is seldom subject to overflow, all of which are features of advantage in the development of water powers. Below Berlin the stream is nowhere more than 10 miles from a railroad, and for considerable portions of its course it is immediately

skirted by railroads. Tide-water navigation extends about 6 miles above the mouth, or to the falls at Brunswick.

ANDROSCOGGIN RIVER AT DIXFIELD, ME.

This station was established August 22, 1902, by F. E. Pressey. It is located about one-half mile west of Dixfield, Me., at the highway bridge on the road between Dixfield and West Peru. The measurements are taken from this bridge, and the initial point for soundings is at the lower end of the inclined end-post on the left bank of the river. The gage is of the usual wire type; the scale board is graduated to feet and tenths, and is nailed to the guard timber of the lower side of the bridge. The gage is read daily at 7 a. m. and 5 p. m. by S. F. Robinson. The channel at this point is about 600 feet wide; the current is swift in the left half and sluggish in the right half. The bed of the stream is rocky in the left half and sandy in the right half. The bench mark is located on the north abutment at the southeast corner of the bridge seat and has an elevation of 24.77 feet above the zero of the gage.

During 1902 the following measurements were made by F. E. Pressey:

August 23: Gage height, 8.85 feet; discharge, 4,665 second-feet.
September 18: Gage height, 8.33 feet; discharge, 3,013 second-feet.

Daily gage height, in feet, of Androscoggin River at Dixfield, Me., for 1902.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		7.55	8.60	9.55	8.55	17		8.35	8.05	8.95	(a)
2		8.15	8.80	9.35	8.50	18		8.35	8.00	8.90	
3		7.95	8.65	9.20	8.50	19		8.20	8.10	8.90	
4		7.90	8.45	9.00	8.45	20		8.65	8.10	8.95	
5		8.00	8.55	8.85	8.40	21		8.55	8.65	8.90	
6		8.05	8.30	8.70	7.70	22	8.25	8.45	8.45	8.90	
7		8.15	8.85	8.70	8.05	23	9.05	8.35	8.30	8.95	
8		8.15	8.50	8.60	8.55	24	9.40	8.40	8.30	8.85	
9		8.10	8.25	8.70	(a)	25	8.90	8.40	8.25	8.75	
10		9.00	8.10	8.50		26	8.55	8.25	8.40	8.70	
11		9.05	8.15	8.50		27	8.45	8.40	8.15	8.70	
12		8.60	8.05	8.50		28	8.30	8.50	9.45	8.65	
13		8.40	7.75	8.65		29	8.25	8.60	11.35	8.50	
14		9.10	8.25	8.80		30	8.15	8.60	9.95	8.70	
15		8.85	8.20	8.90		31	8.10		9.70		
16		8.55	8.15	8.95							

a Frozen December 9 to 31.

ANDROSCOGGIN RIVER AT ERROL DAM, NEW HAMPSHIRE.

Errol dam on the Androscoggin River is the last one of the series of storage dams in the Rangeley Lakes. It is below the mouth of the Magalloway, and consequently stores the flow of that river in Umbagog Lake. The total run-off from the basins of the Magalloway and of

the Umbagog-Rangeley system must pass through this dam. These basins aggregate 1,090 square miles in area. The United States Geological Survey cooperating with Walter H. Sawyer, agent for the Union Water Power Company, of Lewiston, Me., has begun a series of measurements of the flow through the gates at Errol dam. Thirteen measurements of the flow at different gate openings have been made, but the results are not yet available for publication. A continuous record of gate opening is kept, and when a sufficient number of measurements have been made to give a rating for the gates, a constant record of flow will be available.

ANDROSCOGGIN RIVER AT RUMFORD FALLS, ME.

At Rumford Falls there is one of the finest water powers on the Atlantic coast. Here the Androscoggin descends 177 feet in 1 mile, in several pitches over granite ledges. A comprehensive plan of development has been laid out and partially executed. It contemplates the use of power from three levels—a high-level canal, with a fall of 97 feet, to the middle level, the latter receiving also a direct and independent supply of water from the river, the water to be used from the middle-level canal and discharged, after a fall of 50 feet, into the low level, from which in turn there is a final drop of 30 feet to the river. Dams have been built at the entrance of the high and middle level canals. Water for power was first used in important amounts in the summer of 1893, and its use increased from time to time, so that at present about 19,000 horsepower is in use, the greater part being utilized in the manufacture of pulp and paper. If the entire fall of 177 feet were utilized there would be available, at Rumford Falls, from 30,000 to 54,000 horsepower. This power is 85 miles, by rail, from Portland, and for pulp and paper manufacture has the advantage of excellent transportation facilities—Androscoggin River, for floating down pulp wood and timber from the headwaters to the mills, and the Rumford Falls and Rangeley Lakes Railroad, extending into the forests, with a contemplated extension into the Megantic region which will make available additional spruce, poplar, and birch forests. Altogether Rumford Falls possesses the greatest water power in the New England States. Much of it is now unutilized, but it is likely that before long the city of Rumford Falls will be a great manufacturing center.

The discharge of the Androscoggin River at Rumford Falls since 1892 has been computed by Charles A. Mixer, resident engineer of the Rumford Falls Power Company. These figures are obtained by adding the actual measured quantities passing through the wheels and the computed flow over the dam, using the customary Francis weir formula, and they have been published from time to time by the Survey, and a complete record up to 1902 will be found in Water-Supply Paper No. 69.

The following table gives the record for the year 1902:

Mean daily flow, in second-feet, of Androscoggin River at Rumford Falls, Me.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2,084	2,523	6,123	14,078	14,580	9,828	4,170	2,766	1,772	3,005	4,552	2,636
2	1,925	2,103	10,482	12,290	13,521	9,801	4,398	4,618	1,781	3,174	3,880	2,605
3	2,137	2,116	17,245	10,544	14,006	9,350	4,243	4,379	1,713	2,871	3,731	2,600
4	2,131	2,095	10,727	8,627	11,852	9,014	4,243	3,715	1,711	2,549	3,278	2,383
5	2,235	2,068	6,218	7,066	11,557	8,951	4,107	3,134	1,798	2,519	3,119	1,685
6	2,191	2,043	4,593	6,186	11,281	8,293	3,882	2,757	1,882	2,575	2,797	1,618
7	2,195	2,004	3,858	6,169	11,304	7,507	3,625	3,045	1,937	3,072	2,769	1,631
8	2,117	2,044	3,787	5,817	11,155	7,934	3,507	3,198	2,056	2,424	2,728	1,659
9	2,129	2,326	3,633	6,588	10,107	9,202	3,127	3,267	2,028	2,054	2,649	1,781
10	2,019	1,979	3,285	9,980	8,840	8,266	2,974	3,080	3,537	1,905	2,649	1,902
11	2,087	1,939	3,165	7,997	7,483	7,206	2,825	3,101	2,947	1,973	2,603	2,094
12	2,031	1,787	3,626	6,850	7,187	6,478	2,427	3,537	2,699	1,921	2,578	2,181
13	2,023	1,793	6,512	5,900	6,662	6,764	1,965	3,476	2,550	1,940	2,807	1,952
14	1,837	1,776	8,528	5,926	5,177	6,992	2,239	2,909	3,385	2,256	2,923	1,580
15	1,716	1,694	6,482	5,401	4,362	6,619	2,352	2,903	3,184	2,000	3,186	2,049
16	1,769	1,690	5,664	5,059	3,884	6,669	2,379	2,682	2,698	1,939	2,971	2,083
17	1,997	1,644	11,173	4,948	3,851	7,385	2,371	2,506	2,439	1,853	3,385	2,565
18	2,288	1,726	11,690	6,431	3,215	6,357	2,222	2,639	2,261	1,870	3,179	3,083
19	1,962	1,845	7,501	5,778	3,630	4,866	2,163	2,326	2,230	1,958	3,266	2,816
20	1,862	2,135	7,656	5,978	3,583	4,349	1,662	2,382	2,730	2,224	3,267	2,612
21	1,900	2,524	11,126	6,142	3,485	4,295	2,174	2,402	2,534	2,792	3,213	2,055
22	2,646	1,960	12,663	6,700	3,700	4,637	2,734	2,682	2,585	2,451	3,137	2,821
23	8,146	1,819	12,853	7,693	3,852	4,709	3,488	3,935	2,398	2,355	2,936	3,540
24	5,714	1,952	11,479	10,266	4,417	4,068	3,657	3,445	2,372	2,243	3,083	3,277
25	3,835	2,574	8,775	7,080	6,356	3,934	2,996	3,302	2,221	2,147	2,853	2,424
26	3,157	2,436	7,961	7,716	7,645	5,417	2,533	2,741	2,465	2,010	2,789	2,596
27	2,883	2,405	7,774	10,071	9,808	6,987	2,461	2,625	2,559	1,979	2,818	2,630
28	2,718	2,479	8,348	10,303	17,535	5,567	2,133	2,555	2,731	6,936	2,794	2,277
29	2,366	.....	13,178	9,555	15,684	3,573	2,292	2,226	3,002	8,336	2,576	2,294
30	2,474	.....	18,486	13,493	12,077	3,052	2,212	2,013	2,829	5,415	2,414	2,444
31	2,522	.....	15,673	.....	9,847	.....	2,195	1,855	.....	5,113	.....	2,322

Estimated monthly discharge of Androscoggin River at Rumford Falls, Me.

[Drainage area, 2,090 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	8,146	1,716	2,551	1.22	1.41
February	2,574	1,644	2,053	0.98	1.02
March	18,486	3,165	8,718	4.17	4.81
April	14,078	4,948	7,888	3.77	4.21
May	17,535	3,215	8,440	4.04	4.66
June	9,828	3,052	6,604	3.16	3.53
July	4,398	1,662	2,895	1.39	1.60
August	4,618	1,855	2,973	1.42	1.64
September	3,537	1,711	2,438	1.17	1.31
October	8,336	1,853	2,835	1.36	1.57
November	4,552	2,414	3,031	1.45	1.62
December	3,540	1,580	2,329	1.11	1.28
The year	18,486	1,580	4,396	2.10	28.66

PRESUMPSCOT RIVER.

This is one of the most interesting as well as one of the best water-power streams of its size in the United States. It is the outlet of Sebago Lake, which lies about 17 miles northwest of Portland. The lake is fed by Crooked River, a stream heading 35 miles farther north and within 3 miles of the Androscoggin. The area of the lake is 50 square miles, the area of its drainage basin at the outlet of the lake 420 square miles, and the total drainage area of the river at its mouth, 600 square miles. The northern part of the basin is mountainous and wooded, while the southern part is moderately hilly and cleared of trees. Granite, gneiss, and mica-schists appear at many points, and the soil is gravelly and sandy.

According to the survey made by Joseph A. Warren, of Cumberland Mills, the fall from the crest of the stone dam at the foot of Sebago Lake to mean low tide at the foot of the lower falls is 265.16 feet in a distance of 21.65 miles, or an average of 12.25 feet a mile. In the lower two-thirds of this distance, or from Gambo Falls to tide water, nearly one-half of the whole fall, or 132 feet, has been improved, and an aggregate probably exceeding 6,000 net horsepower is in use. The remainder of the fall, however, between Gambo Falls and Sebago Lake, amounting to 133 feet, is either unimproved or but slightly utilized. At Great Falls, in this stretch, there is a descent of 22 feet, which has been used in the past but is now idle. It is proposed, however, to employ the power in the generation of electricity for delivery in Portland.

The tributaries of Presumpscot River are not of much importance, but some of them are outlets of ponds and have considerable fall, thus affording constant though small power. Crooked River, the chief feeder of Sebago Lake, has a number of falls, some of which are utilized.

The chief interest attaching to the river is its regularity of flow which is due to dams at the outlet of the lake. Nowhere in the United States is there a better example of the success of storage of water and regulation of the flow of a stream than on the Presumpscot. Since January, 1887, the flow from Sebago Lake has been regularly recorded, the quantity being deduced from the openings in the gates at the dam, the discharging capacity of which under different conditions of head has been determined and tabulated by Hiram F. Mills of Lowell. Since January, 1872, a continuous record of the level of the lake surface has been kept. An unusually complete and valuable series of data has thus been obtained, which has been furnished to the United States Geological Survey by S. D. Warren & Co. The lake fills rapidly after the first of March, attaining its maximum height between the middle of April and the first of June, and then

gradually subsides as water is withdrawn for mill purposes, until a minimum stage is reached, sometimes in the autumn, but usually in the winter. The records of the daily discharge of the river at the outlet of the lake, published in Water-Supply Paper No. 69, show the remarkable uniformity of flow, which, as already stated, is due largely to artificial regulation. There is no other river in the United States upon which so small variations occur thoughout the year. On Sundays the gates are closed, so that only the waste is allowed to reach the river.

The following table gives the record for the year 1902:

Mean daily flow, in second-feet, of Presumpscot River at outlet of Sebago Lake.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	627	743	667	1,733	2,080	667	583	667	733	667	775	747
2	627	133	167	1,733	2,080	583	583	667	733	667	125	747
3	627	650	337	1,733	2,080	583	583	667	733	667	850	747
4	627	650	673	1,733	1,920	583	583	667	733	667	850	747
5	133	650	673	1,733	1,650	583	583	667	733	133	850	747
6	720	650	673	1,733	1,650	583	583	667	733	450	900	747
7	720	650	673	7,000	1,650	583	667	667	150	450	900	117
8	720	650	673	6,670	1,650	583	667	667	733	450	900	747
9	720	133	167	6,670	1,650	583	667	667	733	700	133	747
10	720	747	687	6,670	1,650	583	667	667	733	700	763	747
11	720	747	687	6,670	1,650	583	667	667	733	700	763	747
12	133	747	515	6,170	1,200	583	667	667	733	133	763	747
13	717	747	687	6,170	1,200	583	667	667	733	687	763	747
14	717	747	687	5,030	1,200	583	667	667	150	687	763	117
15	717	747	687	5,030	1,200	583	667	667	733	687	763	575
16	717	150	687	5,030	1,200	583	667	677	733	687	117	575
17	717	740	680	3,680	1,200	583	667	667	733	687	757	575
18	717	740	680	4,370	1,200	583	667	747	733	687	757	575
19	133	667	680	4,370	667	583	667	747	733	133	757	575
20	367	667	680	4,370	667	583	667	747	733	773	757	575
21	367	667	680	4,100	667	583	667	747	150	773	757	117
22	367	667	680	4,100	667	583	667	747	658	773	757	575
23	733	150	200	4,100	667	583	667	747	658	773	125	575
24	733	333	967	4,100	667	583	667	747	658	773	747	575
25	733	333	967	4,100	667	583	667	733	658	773	747	575
26	133	667	667	4,100	667	583	667	733	658	125	747	575
27	743	667	967	4,100	667	583	667	733	658	817	747	575
28	743	667	967	3,330	667	583	667	733	150	583	747	117
29	743	.....	967	3,330	667	583	667	733	667	583	747	575
30	743	.....	400	2,500	667	583	667	733	667	583	117	575
31	743	.....	967	.....	667	.....	667	150	.....	583	.....	575

Estimated monthly discharge of Presumpscot River at outlet of Sebago Lake, Maine.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	743	133	602	1.43	1.67
February	747	133	589	1.40	1.40
March	967	167	671	1.60	1.84
April	7,000	1,733	4,205	10.01	11.17
May	2,080	667	1,186	2.82	3.25
June	667	583	586	1.40	1.56
July	667	583	651	1.55	1.79
August	747	150	681	1.62	1.87
September	733	150	636	1.51	1.68
October	817	125	598	1.42	1.64
November	900	117	675	1.61	1.80
December	747	117	582	1.39	1.60
The year	7,000	117	972	2.31	31.31

NOTE.—Minima usually occurred on Sunday.

CONNECTICUT RIVER DRAINAGE BASIN.

CONNECTICUT RIVER AT ORFORD, N. H.

This river has its source in Connecticut Lake, in the extreme northern portion of New Hampshire. A gaging and observation station was established August 6, 1900, by E. G. Paul, on the covered highway bridge over the river between Orford, N. H., and Fairlee, Vt., about 75 miles from the source of the stream. The gage for making observations of the variations in the height of water in the river consists of a scaleboard 20 feet long, graduated to feet and tenths, fastened horizontally to the inside timbers on the upper side of the bridge, 125 feet from the left-bank abutment, and a steel sash chain running over a side pulley with a 5-pound weight, the length of the chain from the extreme end of the weight to the copper rivet marker being 42.95 feet.

The observer is Frank H. Gardner, of Orford, N. H.

The following discharge measurements were made during 1902 by Charles A. Holden:

April 10: Gage height, 11.63 feet; discharge, 10,719 second-feet.
November 22: Gage height, 6.80 feet; discharge, 4,474 second-feet.

Daily gage height, in feet, of Connecticut River at Orford, N. H.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	(a)	5.90	12.50	18.30	15.10	15.20	8.30	4.60	4.50	5.40	11.20	5.80
2	.....	.....	20.30	17.65	14.90	12.10	8.10	7.30	4.40	5.20	9.80	5.80
3	.....	.....	27.50	15.80	15.00	10.70	8.50	8.70	4.50	5.10	8.80	5.90
4	.....	.....	25.45	13.80	14.10	12.20	8.90	9.40	4.50	4.80	8.20	5.90
5	8.90	5.70	23.75	12.00	14.00	12.60	8.00	8.40	4.70	5.00	7.90	6.10
6	.....	.....	21.15	11.70	10.80	11.90	7.70	7.40	4.70	5.00	7.40	6.60
7	.....	.....	17.70	11.20	10.70	11.70	7.10	7.20	4.50	5.00	7.20	6.70
8	.....	.....	16.10	10.90	10.05	11.50	7.00	7.10	4.90	5.00	7.00	6.70
9	.....	.....	16.00	10.70	9.30	11.00	6.80	7.00	5.40	5.10	6.70	(b)
10	.....	5.80	16.00	11.30	9.10	12.70	6.80	7.20	6.30	5.50	6.40	.....
11	7.00	.....	16.30	12.80	9.10	12.10	6.60	7.00	7.10	5.60	6.20	.....
12	.....	.....	16.40	13.00	8.50	11.30	6.00	8.10	7.70	5.80	6.00	.....
13	.....	.....	16.90	13.70	8.10	10.50	5.70	10.00	7.60	5.60	6.20	6.60
14	.....	.....	16.40	13.00	7.40	9.60	5.60	8.60	7.40	5.50	7.40	6.70
15	.....	.....	16.10	12.80	7.70	9.40	5.40	7.20	7.00	5.40	8.40	7.10
16	.....	.....	16.00	12.00	7.90	9.20	6.00	7.00	6.70	5.30	8.50	(b)
17	.....	5.40	16.00	10.20	7.60	12.00	6.30	6.70	6.60	5.30	8.50	.....
18	6.40	.....	16.10	10.40	7.30	13.90	6.30	6.20	6.50	5.20	8.00	.....
19	.....	.....	16.00	10.70	7.00	14.30	6.40	5.60	5.20	5.20	7.70	7.10
20	.....	.....	16.20	10.70	7.10	11.40	6.40	5.20	5.00	5.30	7.10	8.00
21	.....	.....	16.20	10.90	7.00	9.00	6.50	4.90	6.80	5.80	7.00	7.40
22	.....	5.10	16.30	12.15	7.20	8.80	6.90	4.80	7.60	7.90	6.80	(b)
23	.....	.....	16.30	12.50	7.10	8.40	7.30	5.60	7.00	7.40	6.70	.....
24	.....	.....	16.00	12.60	7.90	7.90	7.10	6.70	6.60	7.00	6.80	.....
25	6.00	.....	15.90	12.80	8.45	7.50	7.00	7.00	5.50	6.60	6.80	7.00
26	.....	10.40	15.10	13.40	9.90	7.30	6.80	7.90	5.60	6.00	6.60	(b)
27	.....	8.00	14.00	14.80	12.35	9.00	6.40	7.60	5.70	5.60	6.40	.....
28	.....	5.40	12.20	14.90	21.30	10.10	5.90	5.30	5.60	8.40	6.30	.....
29	.....	.....	11.00	15.00	22.40	10.00	5.60	4.80	5.60	16.60	6.20	7.10
30	.....	.....	13.80	14.90	20.00	9.50	5.30	4.70	5.50	14.00	6.00	7.60
31	.....	.....	17.60	.....	17.00	.....	5.00	4.70	.....	12.40	.....	7.70

a Weekly readings January 1 to February 25 through ice.
b Frozen December 9 to 12, 16 to 18, 22 to 24, and 26 to 28.

Estimated monthly discharge of Connecticut River at Orford, N. H.

[Drainage area, 3,050 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	[a] 6,660	[a] 3,500	[a] 4,637	[a] 1.52	[a] 1.75
February	[a] 8,474	[a] 2,686	[a] 3,389	[a] 1.11	[a] 1.16
March	29,165	9,200	16,314	5.35	6.17
April	18,033	8,232	11,483	3.76	4.19
May	22,994	4,500	9,248	3.03	3.49
June	14,282	4,820	8,917	2.92	3.26
July	6,660	2,600	4,235	1.39	1.60
August	7,990	2,268	4,361	1.43	1.65
September	5,260	2,108	3,453	1.13	1.26
October	15,976	2,432	4,234	1.39	1.60
November	9,442	3,500	4,917	1.61	1.80
December	5,600	3,312	4,360	1.43	1.65
The year	29,165	2,108	6,629	2.17	29.58

[a] Weekly readings through ice from January 1 to February 25.

CONNECTICUT RIVER AT HARTFORD, CONN.

Daily readings of the height of water at Hartford have been recorded since February 8, 1896, by Edwin Dwight Graves, chief engineer Connecticut River bridge and highway district, and through his courtesy have been furnished to this Bureau.

These heights are read on what is known as the "Tollhouse gage," the zero of which is set at the low-water mark of 1801.[a] The highest water ever known in the river was in May, 1854—29 feet 10 inches; the lowest, in 1858—1½ inches below zero.

This datum was used in the various surveys of the river below Hartford in 1866–67 (see previous reference); also the survey above Hartford in 1871–1878;[b] also survey of 1897.[c] It is now being used in a further survey of the river above Hartford by an engineer commission appointed by the Secretary of War to study the problem of river improvements above Hartford.

During the low-water periods the tidal wave comes up the river to Hartford. The visible effect of this wave is dependent upon the height of the water and the direction and course of the wind.

[a] See report Theodore G. Ellis, 1867, Ex. Doc. H. R. No. 153, 40th Cong., 2d sess.
[b] Engineer's Report, 1878, pp. 348–391.
[c] Engineer's Report, 1898, pp. 976–988.

From figures given in the Report of the Chief of Engineers for 1878, pages 348–391, and from other data, computations of the discharge of the Connecticut River at Hartford from 1871 to 1886, inclusive, were prepared and published in Part II of the Fourteenth Annual Report of the United States Geological Survey, pages 140–146.

Daily gage height, in feet, of Connecticut River at Hartford, Conn.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	12.6	11.6	15.6	16.7	13.4	11.6	5.6	4.2	3.0	7.0	12.0	3.9
2	10.3	10.7	18.9	13.0	14.5	10.3	5.4	3.9	2.4	7.0	10.2	4.0
3	8.8	11.3	22.6	15.0	13.8	8.8	5.2	3.4	2.2	6.4	8.7	4.3
4	7.4	10.9	25.5	13.3	12.5	7.5	4.8	3.4	3.0	5.2	7.6	4.4
5	8.8	10.5	25.2	12.4	11.5	6.8	6.5	3.8	2.0	4.4	6.8	4.9
6	9.6	9.5	21.7	10.8	10.6	6.5	6.5	4.7	2.0	4.7	6.2	4.4
7	9.7	8.6	17.3	9.8	10.0	6.5	5.9	4.7	1.8	4.8	5.8	3.6
8	9.5	7.8	13.8	9.3	9.2	6.5	5.4	4.5	2.3	4.8	5.5	3.8
9	9.4	6.6	11.9	10.6	8.5	6.3	4.6	4.0	2.5	4.3	5.4	4.2
10	9.0	6.4	12.3	15.7	7.8	6.0	4.2	3.5	2.9	4.1	5.2	4.8
11	8.3	6.2	11.8	17.5	7.3	6.0	3.5	4.5	3.5	4.0	5.0	4.5
12	7.9	5.9	10.8	17.0	6.9	6.4	3.5	7.0	3.8	4.8	5.1	4.8
13	7.2	5.7	12.1	15.4	6.5	6.4	3.4	7.4	4.3	5.8	4.8	5.2
14	6.5	5.5	16.7	13.6	6.0	6.0	3.4	6.9	3.4	5.8	5.0	5.2
15	6.6	5.1	18.7	12.2	5.6	5.5	3.4	6.2	3.4	5.1	4.8	5.6
16	6.3	4.6	17.9	11.0	5.2	5.1	3.2	5.2	4.0	4.5	4.7	6.1
17	6.0	4.6	17.1	10.0	4.8	5.4	3.0	4.8	3.6	3.8	5.0	8.6
18	5.8	4.4	19.4	9.3	4.6	6.1	2.8	4.0	3.4	4.0	5.2	12.6
19	5.3	4.6	20.0	8.6	4.5	7.5	3.0	3.5	3.2	3.6	5.1	13.9
20	5.0	4.0	18.0	8.2	4.5	7.4	3.0	3.4	3.2	3.6	5.0	13.6
21	5.1	4.7	15.4	8.0	4.3	6.9	4.5	3.2	3.8	4.0	4.9	12.4
22	6.3	5.0	14.0	8.0	4.2	6.0	8.0	3.0	4.4	4.1	4.7	13.2
23	11.8	4.6	14.0	8.0	3.9	5.8	7.6	2.8	4.1	4.6	4.2	14.8
24	13.7	4.7	15.0	8.0	3.7	5.7	7.3	2.9	3.8	4.5	4.3	14.7
25	13.4	5.0	15.0	8.7	3.5	5.0	6.5	3.0	3.6	4.6	4.4	12.8
26	12.0	5.1	14.0	8.4	4.0	5.0	6.5	3.4	3.7	4.3	5.4	10.9
27	11.1	6.9	12.7	8.2	5.1	4.4	5.9	3.4	4.0	4.5	5.0	9.7
28	10.4	9.0	11.6	9.8	6.5	4.4	5.3	3.5	4.4	6.0	4.4	8.5
29	12.2	.....	11.4	11.0	9.9	4.5	5.0	3.5	5.3	11.0	4.0	7.5
30	13.0	.....	13.9	10.9	12.2	5.3	4.8	3.4	6.5	14.9	3.7	7.2
31	12.4	.....	16.2	.....	12.5	.....	4.6	3.0	.....	14.0	.....	6.8

MERRIMAC RIVER DRAINAGE BASIN.

MERRIMAC RIVER AT LAWRENCE, MASS.

Records of flow of this river at Lawrence have been kept for more than fifty years, but have never been published in full. Figures for the monthly maximum and minimum discharge from 1890 to 1897 were published in the Nineteenth Annual Report, Part IV; the daily discharge for 1897, 1898, and 1899 in Water-Supply Paper No. 35; the daily discharge for 1900 in Water-Supply Paper No. 47. These figures are furnished by R. A. Hale, principal assistant engineer of the Essex Water Power Company.

For a portion of the year water from the Sudbury and Nashua drainage basins is wasted into the Merrimac. During the dry months a very small amount is received, therefore the drainage area is a somewhat variable quantity. The following tables give the flow of the Merrimac at Lawrence, also the quantity wasted from the Sudbury and Nashua drainage basins, which reaches the Merrimac. The latter table is based on data furnished by the Metropolitan Water and Sewerage Board of Boston. The drainage areas are as follows:

Drainage areas in Merrimac Basin.

	Square miles.
Total Merrimac River drainage basin above Lawrence	4,664
Nashua River drainage basin above gaging station	119
Sudbury drainage basin, Framingham, Dam No. 1	75
Cochituate drainage basin	19
Total Nashua, Sudbury, and Cochituate drainage basins	213
Net drainage basin of Merrimac, excluding Nashua, Sudbury, and Cochituate basins	4,451

The quantity as measured at Lawrence includes the water from Sudbury, Nashua, and Cochituate, and in getting the absolute yield of the river this should be considered in reference to the drainage areas, either by deducting it from the Merrimac flow and using the net area of the Merrimac and the net flow of the Merrimac, or by getting the total yield of both the Sudbury and Nashua with the Merrimac and using the total area.

Estimated monthly discharge of Nashua, Sudbury, and Lake Cochituate drainage basins.

Month.	Nashua River.		Sudbury River.		Lake Cochituate.	
	Average yield.	Average waste.	Average yield.	Average waste.	Average yield.	Average waste.
1901.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*
January	95.5	6.9	50.8	23.9	15.8	0.0
February	65.6	6.5	34.9	12.7	11.9	0.0
March	500.5	255.5	320.5	67.2	72.6	0.0
April	917.8	853.7	489.1	353.4	87.7	31.5
May	502.4	414.6	343.7	290.0	69.9	60.4
June	181.4	78.1	87.6	59.4	19.2	9.8
July	87.8	11.2	35.6	5.3	14.9	0.0
August	94.2	9.9	49.3	36.4	20.8	0.0
September	58.9	7.6	35.5	31.6	19.1	0.0
October	119.1	31.3	47.9	34.3	20.4	0.0
November	95.1	7.9	55.2	58.7	19.5	0.0
December	595.3	425.8	313.6	148.9	69.4	7.5

Estimated monthly discharge of Nashua, Sudbury, and Lake Cochituate drainage basins—Continued.

Month.	Nashua River.		Sudbury River.		Lake Cochituate.	
	Average yield.	Average waste.	Average yield.	Average waste.	Average yield.	Average waste.
1902.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*
January	317.6	136.3	205.1	203.0	39.1	19.6
February	249.5	113.5	194.8	169.2	36.5	12.5
March	739.3	691.5	488.6	342.5	113.6	90.0
April	397.1	265.7	219.3	180.2	51.7	26.1
May	200.4	58.0	86.4	57.3	18.0	11.6
June	91.5	5.8	35.3	2.5	6.0	0.0
July	60.4	5.4	7.6	2.2	7.5	0.0
August	58.0	3.9	15.7	2.2	11.4	0.0
September	48.0	4.1	20.8	2.3	13.0	0.0
October	155.8	38.0	58.8	2.3	15.4	0.0
November	124.0	9.2	51.7	20.4	13.4	0.0
December	320.8	199.7	207.0	103.9	38.7	0.0

Mean daily discharge, in second-feet, of Merrimac River at Lawrence, Mass.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	4,628	2,888	2,360	14,080	16,296	19,479	4,048	4,869	2,010	2,929	3,150	2,435
2	4,574	2,191	1,792	12,510	15,547	16,315	2,881	4,577	2,481	2,508	2,186	4,630
3	4,284	1,630	745	12,580	15,222	15,139	2,694	3,212	4,093	2,703	2,070	3,294
4	3,850	3,919	3,189	18,100	14,601	13,616	603	2,424	3,507	3,012	4,259	3,287
5	2,343	3,007	2,851	31,650	12,554	12,666	2,633	4,404	2,926	1,635	3,168	2,882
6	2,192	2,957	2,991	34,200	11,766	11,270	2,586	3,016	2,916	1,087	3,119	2,754
7	4,462	2,526	2,906	33,950	10,749	9,972	2,463	2,951	1,831	3,626	2,931	2,065
8	3,210	2,531	2,897	61,200	9,831	9,470	3,905	4,722	1,467	2,818	3,048	1,333
9	2,872	1,916	2,116	62,511	8,815	9,653	3,260	11,252	4,086	2,682	1,936	4,103
10	3,284	640	1,851	48,756	9,053	10,520	3,083	8,627	2,879	2,686	1,460	3,628
11	3,796	3,356	4,591	38,023	10,048	9,175	3,522	6,705	2,951	2,557	3,952	4,187
12	2,595	2,726	12,620	31,463	13,099	7,948	3,913	6,982	2,355	1,731	2,873	5,111
13	2,259	2,510	14,060	26,155	15,886	7,024	2,416	5,592	2,519	607	2,618	6,865
14	4,480	2,667	11,920	22,319	14,640	6,571	2,405	4,790	1,599	3,595	2,827	6,447
15	3,402	2,516	9,600	20,832	13,081	5,519	4,315	4,358	1,749	6,149	3,697	9,440
16	3,359	1,846	7,870	19,528	11,072	4,746	3,080	3,941	3,764	13,374	2,615	34,100
17	3,626	889	5,660	17,686	9,684	5,777	2,907	2,928	3,133	11,552	2,361	41,500
18	3,757	3,312	7,690	16,317	8,362	4,808	2,832	3,965	3,182	8,484	4,972	24,200
19	2,712	2,850	6,110	15,627	9,095	4,220	2,959	4,864	1,450	6,509	3,127	15,690
20	2,348	2,785	5,980	15,010	19,104	3,916	2,292	3,619	4,232	5,038	3,138	12,580
21	4,641	2,712	5,770	13,764	28,185	4,186	2,455	3,396	2,602	5,785	3,274	10,390
22	3,408	2,803	12,390	16,027	27,308	3,286	4,055	3,078	1,790	4,575	3,478	7,100
23	3,462	1,929	15,210	21,961	21,863	3,520	3,185	3,017	4,604	4,421	2,164	7,370
24	3,388	560	13,420	26,279	18,063	4,987	2,754	1,968	2,963	3,908	1,661	6,370
25	3,363	3,272	14,110	28,294	16,986	4,382	2,802	3,185	2,615	4,239	4,785	6,750
26	2,415	2,857	13,650	31,770	17,300	4,119	2,753	5,422	2,525	2,805	3,996	9,220
27	2,265	2,476	20,800	29,915	17,588	4,238	1,779	5,132	2,641	2,659	3,893	7,760
28	4,303	2,394	26,350	23,868	18,588	4,013	629	4,721	1,759	4,527	1,461	7,722
29	3,392	.....	26,300	19,629	23,391	2,850	3,755	4,223	300	3,525	4,511	7,568
30	3,075	.....	21,600	16,732	23,766	2,239	3,193	3,659	3,367	3,200	2,765	15,858
31	3,070	.....	15,400	.....	22,417	.....	3,522	2,308	.....	3,054	.....	25,800

Mean daily discharge, in second-feet, of Merrimac River at Lawrence, Mass.—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902												
1	26,500	7,638	22,629	28,212	19,442	7,914	4,069	3,755	2,147	9,696	12,377	5,362
2	22,250	7,471	51,985	24,483	25,470	7,499	4,422	2,057	4,144	9,021	9,338	4,873
3	16,650	9,057	59,889	20,272	20,161	6,408	3,974	2,052	2,961	7,985	9,053	4,569
4	13,090	8,605	61,185	17,209	15,792	5,978	4,465	4,125	2,838	6,477	7,943	5,455
5	11,189	8,313	44,377	14,803	14,881	5,764	7,016	3,170	2,603	5,296	7,179	6,115
6	9,652	7,315	28,452	12,842	14,091	5,476	6,569	2,842	1,468	6,640	6,538	4,782
7	7,856	6,398	21,990	12,015	13,870	4,376	5,650	2,889	512	7,766	6,421	3,481
8	8,130	5,124	19,471	11,374	12,816	3,828	4,937	2,957	2,997	8,643	5,486	5,395
9	7,623	4,947	17,656	15,265	12,424	5,249	4,532	2,235	2,785	7,849	5,200	4,239
10	6,985	5,981	18,624	32,204	10,881	4,697	3,841	2,226	2,780	6,242	6,443	4,422
11	6,130	5,287	18,834	39,195	9,104	5,179	3,973	4,540	2,988	4,884	5,195	4,155
12	5,737	5,098	18,973	35,563	9,162	4,663	2,618	5,371	4,967	4,327	5,161	4,168
13	6,856	4,862	23,909	27,127	7,858	3,856	2,881	8,544	3,655	6,258	5,203	3,409
14	5,387	4,635	33,547	22,988	7,690	3,732	4,503	7,500	3,260	6,370	5,295	3,542
15	5,247	3,502	34,170	19,045	6,799	3,373	3,146	6,082	5,178	5,899	5,385	5,354
16	5,646	3,591	28,373	16,452	6,486	5,009	3,026	4,351	4,914	5,477	5,114	4,234
17	5,701	4,987	26,745	14,485	5,591	4,297	3,493	3,362	4,760	5,061	6,106	4,811
18	5,069	4,180	34,954	13,602	4,814	6,974	3,654	4,806	4,206	4,006	5,251	8,820
19	4,924	4,009	34,583	12,194	6,008	7,067	2,490	3,266	3,236	3,502	5,185	12,509
20	5,821	4,194	26,041	11,090	5,260	5,850	2,595	3,123	2,624	5,263	4,976	11,628
21	5,217	4,120	22,375	11,580	5,444	4,434	4,732	3,066	2,804	5,286	4,787	9,860
22	6,735	2,995	22,754	10,922	5,405	4,118	4,475	3,247	5,081	6,358	4,342	11,812
23	15,405	3,075	23,191	10,713	5,139	5,644	5,511	2,638	3,849	5,831	3,857	17,858
24	21,308	4,835	23,697	10,737	4,224	5,487	5,976	4,052	4,021	5,178	5,234	19,966
25	18,738	3,801	21,764	10,966	4,238	5,077	6,120	5,653	3,867	4,203	4,491	16,553
26	14,659	4,113	19,186	10,138	6,239	4,363	4,977	4,534	3,511	3,510	4,431	14,345
27	13,144	6,870	17,877	11,369	7,018	4,674	4,021	3,944	2,179	5,320	2,935	11,940
28	12,472	12,369	16,966	16,672	10,379	6,680	5,015	3,631	2,106	5,087	5,614	10,307
29	11,416	.....	15,766	15,144	13,962	5,347	3,955	2,906	4,961	15,154	4,065	9,968
30	9,689	.....	22,711	13,106	14,080	5,762	3,887	2,183	6,161	22,253	3,831	8,707
31	8,851	.....	31,751	.....	10,466	.....	3,627	1,551	.....	17,176	.....	9,063

SUDBURY RIVER AT FRAMINGHAM AND LAKE COCHITUATE AT COCHITUATE, MASS.

Sudbury River, a small stream of eastern Massachusetts, receives water from an area west of Framingham. It flows thence in a northerly course through meadows and swamps and joins Assabet River to form Concord River, which in turn continues northerly, entering Merrimac River immediately below the city of Lowell. Storage reservoirs have been constructed by the city of Boston, controlling the greater part of the flow from this basin.

Lake Cochituate drains into Sudbury River a short distance below Framingham. It is controlled as a storage reservoir by the Metropolitan Water Works.

Sudbury River and Lake Cochituate have been studied by the engineers of the city of Boston, the State board of health of Massachusetts, and the Metropolitan Water Board, and records of rainfall in the Sudbury Basin have been kept since 1875, and in the Cochit-

uate Basin since 1852, but the latter are considered of doubtful accuracy previous to 1872. The records of run-off from 1875 to 1898, inclusive, for Sudbury River, were published in the Twentieth Annual Report, Part IV, and those for Lake Cochituate from 1863 to 1899, inclusive, in Water-Supply and Irrigation Paper No. 35.

The following tables, furnished by Frederic P. Stearns, give the results for 1902, also the averages for twenty-eight years.
which records have been taken:

Estimated monthly discharge of Sudbury River at Framingham, Mass.

[Drainage area, 75.2 square miles.]

Month.	Run-off.		Rainfall.
	Second-feet per square mile.	Depth in inches.	
1902.			*Inches.*
January	2.728	3.145	2.52
February	2.590	2.697	6.18
March	6.497	7.491	5.34
April	2.916	3.254	4.13
May	1.149	1.325	1.86
June	.469	.523	2.89
July	.101	.117	2.94
August	.208	.240	3.40
September	.276	.308	4.54
October	.782	.902	4.44
November	.688	.767	1.45
December	2.753	3.173	6.38
The year	1.764	23.942	46.07
Average for 28 years, 1875 to 1902, inclusive.			
January	1.894	2.184	4.20
February	2.911	3.055	4.40
March	4.594	5.296	4.59
April	3.201	3.571	3.44
May	1.776	2.048	3.45
June	.732	.817	2.88
July	.292	.337	3.76
August	.456	.526	4.08
September	.366	.408	3.29
October	.801	.924	4.30
November	1.404	1.566	4.12
December	1.748	2.015	3.87
The year	1.675	22.747	46.38

Estimated monthly discharge of Lake Cochituate at Cochituate, Mass.

[Drainage area, 18.87 square miles.]

Month.	Run-off.		Rainfall.
	Second-feet per square mile.	Depth in inches.	
1902.			*Inches.*
January	2.071	2.388	2.11
February	1.934	2.014	6.67
March	6.022	6.942	5.04
April	2.741	3.058	3.66
May	.955	1.101	1.24
June	.319	.356	2.42
July	.398	.459	3.53
August	.604	.697	3.39
September	.688	.767	4.91
October	.814	.938	4.05
November	.710	.792	1.37
December	2.052	2.366	6.22
The year	1.612	21.878	44.61
Average for 40 years, 1863–1902.			
January	1.749	2.017	3.93
February	2.510	2.636	4.06
March	3.418	3.942	4.44
April	2.627	2.932	3.59
May	1.552	1.789	3.82
June	.694	.775	2.90
July	.469	.541	4.22
August	.672	.775	4.44
September	.660	.736	3.48
October	.914	1.054	4.48
November	1.299	1.449	4.30
December	1.524	1.759	3.58
The year	1.502	20.405	47.24

SOUTH BRANCH OF NASHUA RIVER AT CLINTON, MASS.

Since July, 1896, the flow of the South Branch of Nashua River has been measured at Clinton, Mass., by the engineers of the Metropolitan Water Board. The results of these measurements have been furnished by Frederic P. Stearns, chief engineer. Beginning with 1897 the flow has been corrected for loss and gain of storage in ponds and

mill reservoirs on the watershed, so that the results show the natural flow of the stream. The flow for 1896, however, has not been corrected for storage. The following tables give the results for 1902, also the average for the years 1897–1902.

Estimated monthly discharge of South Branch of Nashua River at Clinton, Mass.

[Drainage area, 119 square miles.]

Month.	Run-off.		Rainfall.
	Second-feet per square mile.	Depth in inches.	
1902.			*Inches.*
January	2.579	2.990	2.72
February	2.168	2.258	4.91
March	6.176	7.120	5.27
April	3.341	3.728	4.36
May	1.595	1.839	2.24
June	.635	.708	2.51
July	.452	.521	3.87
August	.459	.529	3.95
September	.372	.416	4.26
October	1.471	1.696	6.36
November	.982	1.095	.93
December	2.859	3.295	7.20
The year	1.930	26.195	48.58
Average for 6 years, 1897–1902.			
January	1.919	2.212	3.68
February	2.441	2.543	4.33
March	4.913	5.666	5.05
April	4.064	4.534	4.24
May	2.207	2.544	3.90
June	1.172	1.307	3.56
July	.803	.926	4.70
August	.892	1.029	4.83
September	.514	.573	3.34
October	1.000	1.153	3.97
November	1.524	1.700	4.36
December	2.925	3.373	5.36
The year	2.030	27.560	51.32

BLACKSTONE RIVER.

The Blackstone River, rising in Massachusetts and flowing to tide water at Providence, R. I., is one of the great water-power rivers of the United States. Its flow is largely affected by the many dams built across the river for the development of water power. A station for systematically measuring the flow of the Blackstone was established in May, 1901, by John E. Hill, professor of civil engineering, Brown University, and measurements of flow have been made under his charge by four students of the university, George H. Gilbert, Henry D. Browne, E. Vanderbilt, and R. P. Hovey. The station is located at a bridge about one-fifth of a mile west of the New York, New Haven and Hartford Railroad station at Berkeley. The drainage area at this point is 429 square miles. At this point the Blackstone River is paralleled by Blackstone canal, and measurements of the canal are usually made immediately after the measurements of the river are completed. The canal begins at the Ashton dam, three-fourths of a mile upstream, and terminates at the Lonsdale mills, 2 miles below the station. Throughout the late spring and summer the gates at Lonsdale are closed at 12.30 p. m. on Saturdays. The combined flow of the river and canal represents the total flow from the drainage area of the Blackstone above Berkeley. The gagings are made from bridges over the river and canal. The gages are vertical rods nailed to the bridges, the river gage being referred to two bench marks—the first is a large stone 20 feet south of road, 90 feet east of bridge, and 12 feet southwest of old oak tree, the elevation being 8.87 feet; the second is the west end of stone doorsill to office of Berkeley Mills; elevation, 18 feet. There are two benches for the canal gage, the first being the top of the same stone as used for the river gage, its elevation being 2.10 feet below the zero of the gage rod, while the stone sill just described has an elevation of 7.03 feet. The banks of both the river and canal are high, the river having a straight course above the station, though slightly curved below. The gages were read twice a day, 7.30 a. m. and 4.30 p. m., by Joseph A. Ray, master mechanic in the Berkeley Mills, from May 17 to August 17, and since September 22 by A. E. Glover, station agent, New York, New Haven and Hartford Railroad.

The following tables of discharges and gage heights give the data which was collected to that date.

February 27: Gage height, 4.27 feet; discharge in river, 2,118 second-feet.
March 4: Gage height, 5.10 feet; discharge in river, 3,791 second-feet.
February 27: Gage height, 3 feet; discharge in canal, 74 second-feet.

Daily gage height, in feet, of Blackstone River at Berkeley, R. I.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1902.											
1	.....	4.50	8.35	4.25	4.45	4.10	3.90	3.90	4.10	4.20	4.00
2	.....	4.50	7.75	4.35	4.45	4.20	4.00	3.90	4.05	4.20	4.00
3	.....	3.85	6.75	4.30	4.15	4.20	3.90	3.90	4.00	4.30	3.90
4	.....	4.50	5.10	4.30	3.85	4.10	3.90	3.80	3.90	4.30	3.90
5	5.15	4.40	4.85	4.35	4.35	4.10	4.00	3.95	4.00	4.40	4.05
6	5.05	4.30	4.70	3.90	4.30	4.10	4.00	3.85	4.00	4.40	4.00
7	4.50	4.30	4.90	4.30	4.30	4.10	4.15	3.95	4.00	4.45	3.90
8	4.45	4.30	5.05	4.40	4.15	4.00	4.20	4.00	4.00	4.30	3.85
9	4.30	3.30	5.25	4.65	4.15	4.00	4.20	3.90	4.20	4.35	4.10
10	4.20	4.35	5.35	5.25	4.15	4.10	4.10	3.80	4.20	4.40	3.95
11	4.40	4.30	5.50	4.80	4.00	4.10	3.90	3.80	4.10	4.40	3.90
12	4.00	4.30	5.45	4.50	4.20	4.10	3.90	3.90	4.20	4.25	4.10
13	4.15	4.15	5.50	3.90	4.30	4.25	3.80	4.10	4.00	4.30	3.95
14	4.05	4.10	5.30	4.60	4.20	4.20	4.05	4.10	4.00	4.50	3.90
15	4.20	4.25	4.70	4.50	4.25	4.00	4.15	3.95	4.20	4.50	4.00
16	4.15	4.00	4.00	4.60	4.15	4.10	4.20	3.90	4.20	4.40	.....
17	4.05	4.20	5.15	4.40	4.05	4.00	4.30	3.80	4.10	4.30	.....
18	4.00	4.20	6.00	4.25	4.10	4.00	4.25	3.95	4.20	4.30	.....
19	3.95	4.30	5.55	3.95	4.20	4.05	4.20	4.10	4.20	4.30	.....
20	4.05	4.30	4.75	3.80	4.20	4.10	4.00	4.10	4.20	4.20	.....
21	4.25	4.25	4.55	4.40	4.05	3.90	4.00	4.00	4.05	4.10	.....
22	5.05	4.25	4.25	4.30	4.00	3.80	3.90	4.00	4.00	4.10	.....
23	5.60	4.30	4.00	4.20	4.00	4.00	3.90	3.90	3.90	4.20	.....
24	4.60	4.25	4.40	4.05	4.05	4.00	4.00	3.95	3.90	4.00	.....
25	4.50	4.35	4.40	4.20	4.00	4.10	4.00	4.00	4.05	4.00	.....
26	4.35	4.40	4.45	3.90	4.05	4.20	4.10	4.10	4.15	4.30	.....
27	4.40	4.45	4.30	3.90	4.10	4.10	4.00	4.10	4.20	4.25	.....
28	4.50	5.15	4.10	4.30	4.20	4.10	3.90	4.00	4.10	4.20	.....
29	4.65	.....	4.20	4.25	4.20	3.90	3.90	4.00	4.05	4.20	.....
30	4.60	.....	4.20	4.25	4.25	4.10	4.00	3.95	4.15	4.20	.....
31	4.60	.....	4.65	.....	4.20	.....	4.05	4.10	.....	4.10	.....

Daily gage height, in feet, of Blackstone canal at Berkeley, R. I.

Day	Jan.	Feb.	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1902.											
1	.....	2.90	.....	3.25	3.25	2.90	3.10	2.80	2.30	2.30	2.20
2	.....	3.00	.....	3.20	3.30	2.90	2.90	2.60	2.40	2.35	2.30
3	.....	3.00	.....	3.15	3.25	2.85	2.90	2.60	2.35	2.30	2.50
4	.....	2.90	.....	3.05	3.05	2.80	3.00	2.60	2.30	2.30	2.50
5	3.40	2.90	.....	3.05	3.10	2.70	2.95	2.60	2.25	2.30	2.50
6	3.05	2.90	.....	3.00	3.00	2.90	3.00	2.65	2.40	2.30	2.40
7	2.90	2.90	.....	3.15	3.10	2.80	2.85	2.60	2.30	2.35	2.40
8	2.90	2.90	.....	3.15	3.10	2.95	2.90	2.60	2.20	2.40	2.35
9	2.90	3.20	.....	3.30	3.15	2.90	2.90	2.50	2.30	2.20	3.30
10	2.90	3.00	.....	3.25	3.20	(b)	2.85	2.60	2.30	2.10	2.95
11	3.00	2.95	.....	3.20	3.30	(b)	2.85	2.60	2.40	2.15	2.85
12	3.10	2.90	.....	3.00	3.05	(b)	2.95	2.65	2.30	.....	3.10
13	3.00	3.00	.....	2.90	3.05	(b)	(b)	2.70	2.20	.....	2.85
14	2.95	3.00	.....	3.10	2.90	(b)	2.80	2.65	2.20	.....	2.75
15	2.90	3.10	.....	3.10	3.00	3.00	2.80	2.60	2.20	.....	2.45
16	2.90	3.20	.....	3.05	2.30	2.90	2.89	2.70	2.30	.....	.....
17	2.90	3.00	.....	3.05	1.80	2.80	2.90	2.80	2.30	.....	.....
18	2.90	2.90	.....	2.90	2.90	2.80	2.80	2.60	2.40	.....	.....
19	3.00	2.90	.....	3.00	2.95	2.90	2.80	2.30	2.30	2.10	.....
20	2.90	3.05	.....	3.30	3.00	2.85	(b)	2.30	2.25	2.45	.....
21	2.90	3.00	.....	3.20	3.05	2.95	(b)	2.30	2.20	2.80	.....
22	3.20	3.10	.....	3.10	3.00	3.05	(b)	2.30	2.10	2.50	.....
23	3.30	3.20	.....	3.10	2.95	2.90	2.80	2.30	2.25	2.50	.....
24	3.20	2.95	.....	3.10	(b)	2.95	2.70	2.50	2.30	2.45	.....
25	3.10	3.00	.....	3.10	(b)	3.00	2.70	2.30	2.45	2.20	.....
26	3.00	3.10	.....	3.15	(b)	2.90	2.80	2.30	2.35	2.70	.....
27	3.00	3.15	3.20	3.20	2.85	2.90	2.70	2.35	2.25	2.70	.....
28	2.90	3.35	3.10	3.10	2.90	2.95	2.75	2.40	2.25	2.80	.....
29	2.95	.....	3.10	3.10	.....	2.90	2.75	2.40	2.10	2.60	.....
30	2.90	.....	3.60	3.10	.....	2.90	2.70	2.30	2.20	2.60	.....
31	2.90	.....	3.45	.....	.....	.....	2.70	2.30	.....	2.60	.....

[a] No records on account of canal bank having washed out. [b] Repairing canal.

WATER POWERS OF NEW YORK.

The following pages contain the results of gagings of streams in the State of New York, made by the Division of Hydrography of the United States Geological Survey in cooperation with the State engineer of New York. The work has been under the immediate supervision of Mr. Robert E. Horton. Acknowledgment is made of the hearty cooperation and assistance afforded by Edward A. Bond, State engineer and surveyor, and William Pierson Judson, deputy State engineer, as well as by many civil engineers, water-power users, and other individuals.

The methods of stream gagings utilized in New York State have been fully described in Water-Supply Paper No. 65, pages 91 to 98. The methods there described have been continued during the year 1902, and, in addition, particular attention has been devoted to securing reliable data relative to the yield of streams during the winter months and to the experimental determination of the best methods of

current-meter use on each of the streams. In addition, some attention has been devoted to the gagings of some very small watersheds not subject to any storage or artificial control.

Information concerning the yield of streams during the winter months is of great value wherever water power is used for electric-lighting purposes, as the heaviest load and hardest service usually occur in the winter. It is, however, a somewhat more difficult matter to secure reliable records of stream flow when the rivers are frozen over than during the open season. Where gaging stations are located at dams ice is likely to accumulate on the crest of the overflows, diminishing their effective capacity. At current-meter gaging stations the rating curves applicable during summer months may be inapplicable when the stream is frozen over, owing to the increase in the wetted perimeter.

Measurements of the run-off from small, uncontrolled watersheds of the Appalachian region are a matter of growing interest, inasmuch as the public water supplies of very many of the cities and towns of the region are drawn from such sources in preference to taking supplies from larger rivers and streams which contain greater pollution from sewage and manufacturing waste. The extent to which such gagings of small watersheds can be carried on is limited, owing to the fact that to obtain a given per cent of precision equal if not greater care is required in gaging a small stream than in gaging a large one. The number of such streams is, moreover, very great, and the number of persons likely to be interested and directly benefited by the measurement of any single stream is relatively small. Especial thanks are rendered to William S. Bacot, consulting engineer, Utica, N. Y.; also to the Consolidated Water Company, of Utica, N. Y., and the Greenwich Water Company, of Greenwich, Conn., for affording facilities for obtaining gaging records on a number of small natural watersheds in New York State.

The appropriating clause in chapter 594 of the New York State Laws of 1902 requires that the State shall cooperate with the United States Geological Survey in "determining the water supply available for canals and for potable and domestic uses and for the development of water power."

As illustrating the value of water resources of New York to the State, the following statistics from the Twelfth United States Census are given. They show an aggregate power of installed water wheels of 330,543 horsepower in 1900. In 1880 the water power in use in the State was determined by the census officials to be 219,348 horsepower. Since the census of 1900 was taken water-power development costing many millions of dollars has been completed. A large part of the power thus rendered available is utilized for electric lighting of municipalities and for electric traction purposes, two classes of power users which are not represented in the census returns.

The following table is a list of the various industries in New York which depend upon water power:

Industries in New York State dependent on water power.

Industry.	Number of establishments.	Horse power	Industry.	Number of establishments.	Horse-power.
Agricultural implements	19	1,101	Linen goods	1	100
Boots and shoes	7	590	Lumber	278	24,003
Brick and tile	1	50	Lumber and timber products	450	21,321
Carpets and rugs	5	1,660	Paper	175	189,737
Carriages and wagons	25	1,006	Printing and publishing	56	305
Chemicals	14	514	Ship building	4	1,541
Cordage and twine	3	800	Shoddy	5	299
Cotton goods	16	8,494	Silk manufacturing	7	828
Cotton small wares	1	36	Wool hats	2	275
Dyeing and finishing	5	560	Woolen goods	46	4,493
Felt goods	4	862	Worsted goods	3	3,310
Flour and grist mills	1,053	58,775	Total		330,543
Hosiery and knit goods	71	7,164			
Iron and steel	3	1,300			
Leather, tanned and curried	34	1,419			

LAKE ONTARIO DRAINAGE BASIN.

MOOSE RIVER AT MOOSE RIVER, N. Y.

The gaging station on this stream is situated at the village of Moose River, 4 miles below McKeever railroad station. It was established June 5, 1900. The watershed is described in Water-Supply Paper No. 65, pages 98 to 100, and the mean of the two gage readings which are taken each day, is tabulated for 1900 in Water-Supply Paper No. 49, page 235, and for 1901 in Water-Supply Paper No. 65, page 99. The average daily gage heights for 1902 deduced from the observations by Christopher Hannan, the gage reader, are given in the accompanying table.

Mean daily gage height, in feet, of Moose River at Moose River, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	1.75	1.15	2.85	4.60	4.90	2.80	1.85	1.05	0.60	1.05	2.55	1.85
2	2.15	1.10	3.85	4.20	3.65	2.65	2.05	1.35	.90	.85	2.35	1.75
3	2.20	1.20	5.05	3.95	3.60	2.40	2.75	1.60	.65	.95	2.15	1.65
4	2.10	1.30	5.25	3.65	3.65	2.70	4.50	1.55	.70	1.05	1.95	2.30
5	2.25	1.40	4.80	3.45	3.55	2.90	3.55	1.40	.85	1.20	1.75	2.30
6	2.45	1.40	4.20	3.30	3.05	2.45	2.90	1.75	.80	1.30	1.75	1.90
7	2.25	1.50	3.75	3.25	2.80	2.25	2.50	3.10	.80	1.45	1.75	1.50
8	2.15	1.40	3.55	3.20	2.45	2.15	2.25	2.85	.55	1.55	1.55	1.20
9	2.15	1.40	3.15	3.10	2.20	2.70	2.05	3.50	.65	1.45	1.55	1.75
10	1.95	1.40	2.85	4.60	2.05	2.55	1.85	2.70	.80	1.30	1.45	1.65
11	1.60	1.40	2.65	4.45	1.95	2.45	1.65	2.25	.85	1.25	1.25	1.75
12	1.25	1.30	2.65	4.20	1.70	2.25	1.55	2.70	1.10	1.20	1.60	1.85
13	2.25	1.35	3.40	3.60	1.55	2.10	1.45	2.10	1.40	1.10	2.25	1.75
14	2.45	1.45	4.65	3.85	1.65	2.05	1.55	1.80	1.30	1.45	2.90	1.75
15	2.40	1.45	3.45	3.25	1.45	2.25	1.80	1.45	1.35	1.55	2.70	1.85
16	2.25	1.45	4.50	4.00	1.25	2.45	1.75	1.25	1.25	1.35	2.35	1.70
17	2.05	1.45	6.00	4.40	1.20	2.25	1.45	1.15	1.15	1.15	1.95	2.00
18	2.25	1.45	(a)	3.40	1.10	2.05	1.35	1.05	1.25	1.15	1.95	2.30
19	2.05	1.60	(a)	2.85	1.05	1.85	1.65	1.05	1.25	1.25	1.75	2.25
20	1.85	1.75	(a)	2.50	1.10	2.15	2.95	1.00	1.10	1.25	1.75	2.05
21	1.75	1.90	4.50	2.85	1.00	2.25	2.25	1.05	1.15	1.45	1.65	1.90
22	1.70	1.90	4.15	2.50	.85	2.85	2.05	1.10	1.20	1.55	1.65	2.90
23	1.70	2.00	3.80	3.05	1.10	2.40	1.85	1.15	1.10	1.35	1.85	3.65
24	1.80	2.10	3.75	2.75	1.80	1.95	1.55	1.10	1.05	1.25	1.95	3.35
25	1.65	2.10	3.60	2.50	2.65	1.85	1.45	1.95	1.20	1.45	1.75	3.05
26	1.55	2.05	3.40	3.10	3.30	1.95	1.80	.85	1.25	1.65	1.75	2.85
27	1.35	2.05	3.15	4.80	3.90	2.40	1.40	.80	1.20	1.75	1.75	2.65
28	1.40	2.25	3.10	4.25	3.45	2.10	1.05	.75	1.30	1.95	1.95	2.45
29	1.30	.....	4.05	3.75	3.25	1.85	.95	.65	1.20	3.35	1.80	2.25
30	1.30	.....	6.40	4.75	3.35	1.55	1.00	.65	1.25	3.95	1.75	2.05
31	1.20	.....	5.20	.....	3.50	.....	1.10	.65	.....	3.20	.....	1.95

(a) Ice breaking up; water above top of gage.

BEAVER RIVER NEAR CROGHAN, N. Y.

Beaver River, like Moose River, is a stream draining a portion of the western Adirondack slope of New York. The watershed is described in Water-Supply Paper No. 65, pages 100 to 102. The gaging station was established at Tisses Bridge, situated between the villages of Croghan and Belfort, May 17, 1901. Daily gage heights from the readings taken once each day by Nicholas Tisse are given for 1901 in the Water-Supply Paper above cited. The observations for 1902 are contained in the following table.

August 6, 1902, a current-meter discharge measurement was made by C. C. Covert. Gage height, 2.32; discharge, 554 second-feet.

Daily gage height, in feet, of Beaver River at Tisses Bridge, near Croghan, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	3.0	2.5	3.4	4.5	4.5	3.4	3.0	2.5	2.2	2.0	2.7	2.4
2	2.9	2.4	4.5	4.4	2.0	3.2	2.7	2.5	2.0	2.1	2.5	2.3
3	2.8	2.4	4.4	3.7	4.0	3.0	2.4	3.4	2.6	2.2	2.3	2.6
4	2.8	2.4	3.9	3.5	4.0	3.2	2.4	3.0	2.4	2.2	2.0	2.7
5	2.9	2.4	3.7	3.4	4.5	3.0	2.5	2.4	2.0	2.0	2.0	2.7
6	2.7	2.4	3.5	2.0	4.2	3.4	2.5	2.4	2.0	2.2	1.9	2.7
7	2.7	2.4	3.4	1.4	4.4	3.6	2.4	2.2	2.0	2.1	1.9	2.6
8	2.7	2.4	2.4	3.5	5.0	3.6	2.5	2.3	2.0	2.2	2.0	2.6
9	2.6	2.3	2.5	4.2	4.4	3.2	2.4	2.4	2.1	2.2	2.2	2.9
10	2.6	2.4	2.5	4.1	4.0	3.9	2.5	3.0	2.0	2.1	2.4	2.9
11	2.5	2.3	2.7	4.2	3.6	3.6	2.5	2.7	2.2	2.1	3.0	3.0
12	2.5	2.3	3.3	4.4	2.9	3.2	2.5	2.4	2.3	2.2	3.2	3.2
13	2.5	2.3	4.4	4.3	4.2	2.5	2.4	2.0	2.2	2.0	3.2	3.4
14	2.5	2.2	4.9	3.4	2.4	2.2	2.5	2.0	2.2	2.0	2.9	3.5
15	2.5	2.4	4.8	3.0	2.2	2.4	2.6	2.0	2.0	1.2	2.7	3.5
16	2.5	2.4	4.9	3.0	4.4	3.2	3.0	2.1	1.8	1.2	2.7	3.4
17	2.5	2.4	5.0	3.2	5.0	3.7	3.2	3.2	1.8	2.2	2.4	3.4
18	2.5	2.6	5.4	2.9	4.6	2.8	3.2	3.4	2.0	2.2	2.6	3.3
19	3.2	2.7	5.2	4.2	4.2	3.3	3.0	3.1	1.9	2.3	2.7	3.2
20	3.1	2.8	4.8	4.3	2.6	3.8	3.0	2.7	1.9	2.2	2.7	3.0
21	3.1	2.8	4.4	2.3	4.2	3.8	3.0	2.4	1.8	2.3	2.5	3.0
22	2.9	2.9	4.0	2.6	4.4	3.5	2.9	3.3	1.8	2.4	2.2	2.9
23	2.7	2.9	4.4	3.4	4.2	3.8	2.8	3.2	1.9	2.4	2.4	2.9
24	2.6	2.9	4.4	4.2	4.2	2.6	2.8	3.0	1.8	2.2	2.4	3.1
25	2.5	2.7	4.0	3.5	5.2	2.8	2.9	3.0	2.0	2.3	2.4	3.0
26	2.5	2.8	3.9	3.2	5.4	2.4	2.8	2.5	1.8	3.2	2.4	2.9
27	2.5	2.9	4.0	4.3	5.6	2.2	2.5	2.2	1.8	3.0	2.3	2.8
28	3.3	3.7	3.7	3.0	4.2	2.4	2.5	2.2	2.0	3.0	2.3	2.7
29	3.1	.....	4.0	4.6	3.4	2.4	2.4	2.2	2.0	2.9	2.3	2.7
30	2.7	.....	4.5	3.7	3.5	2.3	2.6	2.2	2.1	2.8	2.4	2.5
31	2.2	.....	4.4	.....	3.4	.....	2.4	2.1	.....	2.7	.....	2.6

BLACK RIVER NEAR FELTS MILLS, N. Y.

A gaging station maintained on Black River at Huntingtonville dam, near Watertown, from February 22, 1897, to December 13, 1901, is described in Water-Supply Paper No. 49, pages 236 to 239, and in Water-Supply Paper No. 65, pages 102 to 105. Owing to the washing out of a portion of the right wing of the Huntingtonville dam by a freshet, the record for Black River was transferred during 1902 to the dam of the Black River Traction Company, 2 miles above Felts Mills.

This dam is situated 9 miles above Watertown and 7 miles above the Huntingtonville gaging station, on the same stream. The drainage area is estimated at 1,851 square miles, or 37.5 square miles less than that at Huntingtonville. The intervening area is mainly drained by two small streams—Townsend Creek and Rutland Hollow Creek.

The dam is of squared timber and has a slope on the upstream face of 2.86 horizontal to 1 vertical. The crest is protected by boiler plate, and the downstream face is vertical, giving a free overfall. The main crest is 380.6 feet in length, is level, and at an elevation of 587.96 feet above tide. There are two additional sections on the right side; one, at an elevation of 590.96 feet, is 14.1 feet long, and the other, at an elevation of 593.46 feet, is 17.9 feet in length.

A similarly constructed dam 117 feet long at the left bank serves as an auxiliary spillway and as a headrace wall. It has an average crest elevation of 591 feet.

The gage is attached vertically to a crib at the juncture of the main and auxiliary spillways, 8 feet upstream from the crest, and a correction is made to the gage readings for velocity of approach during high water. The discharge over the spillways has been calculated by means of the weir formula, using coefficients derived from Cornell experiment No. 5 for a dam of similar cross section. The dam was constructed in 1900, rests on limestone foundation, and is very nearly water-tight. The headrace is closed by a bulkhead, no water wheels having been installed.

The gage readings are taken twice daily, at 7 a. m. and again at 6 p. m., by A. H. Tucker. A record of high water was kept at this dam May and June, 1901. The results are not available for publication at present.

Mean daily flow, in second-feet, of Black River at Black River Traction Company's dam, near Felts Mills, N. Y., for 1902.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3,460	4,220	7,180	5,560	18		3,805	4,360	5,880	5,250
2		3,590	4,140	6,200	5,100	19		3,720	4,080	5,780	6,550
3		3,940	4,280	5,880	4,940	20		3,400	4,565	5,880	6,300
4		3,860	3,860	5,100	8,740	21		3,000	4,800	5,245	6,830
5		3,665	3,180	4,500	7,920	22		3,720	5,100	5,245	7,610
6		3,460	4,000	4,420	5,880	23		3,540	4,500	4,500	9,960
7		2,860	4,800	4,420	6,040	24		3,130	4,940	5,780	10,830
8		4,080	4,800	4,500	5,660	25		3,265	4,360	5,160	9,720
9		4,140	5,000	4,420	5,400	26		3,540	4,420	4,720	9,070
10		4,140	4,650	4,280	5,190	27		3,180	4,800	5,720	7,700
11		5,245	4,650	4,220	4,660	28		3,940	5,245	6,200	6,800
12		4,800	3,940	4,280	4,020	29	3,590	4,280	7,285	6,200	6,300
13		4,280	4,140	8,370	4,010	30	3,590	3,540	8,370	5,190	6,020
14		3,665	4,940	8,840	4,170	31	3,400		8,465		5,800
15		4,080	5,310	9,080	3,940	Average	3,527	3,771	4,857	5,655	6,265
16		3,940	4,940	7,285	4,310						
17		3,860	4,420	6,200	3,960						

Estimated monthly discharge of Black River at Black River Traction Company's dam, near Felts Mills, N. Y.

[Drainage area, 1,851 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
August 29–31	----------	----------	3,527	1.90	2.19
September	5,245	3,000	3,771	2.04	2.28
October	8,465	3,180	4,857	2.62	3.02
November	9,080	4,220	5,655	3.05	3.52
December	10,830	3,940	6,265	3.38	3.90

SALMON RIVER NEAR PULASKI, N. Y.

The gaging station on this stream is located at Fox Bridge, 2 miles above Pulaski village. The station was established September 5, 1900, and is described in Water-Supply Paper No. 49, page 234, and in No. 65, pages 105 to 107, where gage heights and estimated daily discharge are given.

Owing to obstruction of the stream by ice, and injury to the gage, the Salmon River record was interrupted during the winter of 1901–2.

A new gage was erected July 23, 1902, and the record resumed. The datum of the weight gage is at an elevation of 87.21, or 1.2 feet below that of the original gage. All gage readings and discharge measurements have been reduced to the original or board gage datum. Gage readings are taken twice daily by S. J. Fox. The gage is of the weight and wire variety, with a 15-foot decimal scale, near the center of the right bridge span. The following current-meter discharge measurements have been made during 1902:

Current-meter discharge measurements of Salmon River near Pulaski, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.[a]	*Second-feet.*
October 17	R. E. Horton	2.85	433
July 23	H. R. Beebe	3.29	842
July 2	Horton and Beebe	3.74	1,392
July 5	H. R. Beebe	4.73	2,889
July 6	do	4.83	2,916
Do	do	4.86	2,881

[a] Referred to old or original gage datum.

Salmon River, in common with other streams tributary to eastern Lake Ontario, is subject to great obstruction by anchor ice. Owing

to this, separate discharge measurements are required for the winter season before the gage readings for the ice period can be reduced to quantities of discharge. Arrangements have been made for the taking of such measurements during the coming winter.

Mean daily flow, in second-feet, of Salmon River near Pulaski, N. Y., for 1902.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	394	294	378	692	708	18	.....	442	246	506	692	1,301
2	.....	1,640	330	330	618	618	19	.....	756	220	650	820	1,110
3	.....	884	378	378	570	674	20	.....	692	246	735	905	990
4	.....	650	330	330	554	2,135	21	.....	554	234	618	756	862
5	.....	490	474	282	258	1,244	22	.....	554	246	522	692	1,015
6	.....	535	282	570	522	692	23	862	671	234	570	1,215	883
7	.....	554	294	246	650	586	24	714	586	234	634	1,010	1,098
8	.....	820	378	258	586	538	25	714	474	234	793	820	1,131
9	.....	820	362	777	388	442	26	607	410	246	671	735	1,011
10	.....	692	1,470	586	474	554	27	538	394	294	708	862	905
11	.....	820	799	506	474	708	28	671	362	294	947	1,157	777
12	.....	1,325	586	426	474	798	29	535	306	306	1,301	798	884
13	.....	798	474	394	1,914	841	30	346	294	378	976	862	905
14	.....	1,442	394	618	1,552	1,011	31	362	282	.....	777	.....	841
15	.....	490	362	884	1,131	1,032	Average	594	611	375	615	796	934
16	.....	410	346	692	976	1,340							
17	.....	394	282	998	735	1,340							

Estimated monthly discharge of Salmon River near Pulaski, N. Y.

[Drainage area, 264 square miles.]

Month.	Mean discharge in second-feet.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.			
July	594	2.25	2.59
August	611	2.32	2.67
September	375	1.42	1.58
October	615	2.33	2.69
November	796	3.02	3.37
December	934	3.54	4.08

CHITTENANGO CREEK AT CHITTENANGO, N. Y.

This gaging station, which was established May 22, 1901, is described in Water-Supply Paper No. 65, pages 114 to 116, where daily gage heights and discharge measurements for 1901 may be found. The greatest known freshet on this stream occurred December 15, 1901. The water rose to elevation 7 on the gage board. This freshet went over the tops of the abutments and the adjacent highway. It also caused scour underneath the bridge, so that the discharge measure-

ments of 1902 are not strictly comparable with those of 1901 for similar stages of the stream. The following current-meter measurements have been made during 1902:

Current-meter discharge measurements of Chittenango Creek at Chittenango, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
December 13	C. C. Covert	1.70	66.7
August 23	do	1.77	70.8
April 2	E. C. Murphy	2.33	205.0
Do	do	2.33	212.0
July 2	R. E. Horton	2.34	[a] 184.0
Do	do	2.36	216.6
July 7	H. R. Beebe	2.50	280.6
Do	do	2.49	280.4

[a] At Polytechnia street bridge.

Mean daily gage height, in feet, of Chittenango Creek at Chittenango, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2.00	1.80	4.95	2.30	1.70	1.85	2.25	2.35	1.45	1.90	1.90	1.75
2	2.00	1.80	4.52	2.30	1.70	1.80	2.00	2.45	1.65	2.15	1.90	1.75
3	2.00	4.05	4.10	2.20	1.70	2.00	2.50	2.20	1.60	1.90	1.90	2.00
4	2.00	2.80	3.50	2.30	1.70	3.65	2.30	2.10	1.60	1.90	2.00	1.80
5	2.00	2.90	3.00	2.30	1.70	2.70	2.40	2.00	1.60	1.90	2.20	1.80
6	1.95	2.60	2.30	2.30	1.70	2.40	2.73	3.00	1.60	2.10	2.20	1.80
7	1.85	2.60	2.45	2.30	1.70	2.20	2.80	2.40	1.55	2.20	2.20	1.80
8	1.80	2.30	2.60	2.20	1.70	2.50	2.50	2.45	1.50	2.25	2.15	1.80
9	1.70	2.00	2.60	2.90	1.70	2.50	2.30	2.25	1.65	2.20	2.10	1.75
10	1.70	1.85	2.60	3.05	1.70	2.60	2.68	2.20	2.65	2.10	1.85	1.75
11	1.70	1.70	2.77	2.60	1.65	2.75	2.35	2.20	1.70	2.10	1.85	1.75
12	1.70	1.70	4.05	2.60	1.60	2.90	2.10	2.10	1.60	2.05	1.95	1.80
13	1.70	1.70	4.30	2.60	1.60	2.50	2.00	2.00	1.50	1.95	1.90	1.80
14	1.70	1.70	3.30	2.50	1.60	2.35	2.20	1.95	1.50	1.85	1.90	1.80
15	1.70	1.70	3.10	2.50	1.60	2.85	2.25	1.90	1.70	1.80	2.00	1.80
16	1.70	1.70	3.10	2.33	1.60	2.75	2.20	1.85	1.70	1.85	2.00	2.40
17	1.70	1.70	4.30	2.20	1.60	2.45	2.05	1.90	1.70	2.00	1.95	2.30
18	1.70	1.70	3.30	2.20	1.60	2.20	2.00	1.90	1.70	2.10	1.90	2.20
19	1.70	1.70	2.80	2.20	1.70	2.13	2.00	1.90	1.70	2.33	1.90	2.23
20	1.70	1.70	2.60	2.20	1.80	2.10	2.65	1.85	1.70	1.95	1.80	2.20
21	1.70	1.70	2.60	2.10	1.75	2.20	2.65	1.80	1.70	1.75	1.80	2.20
22	1.85	1.80	2.80	2.00	1.70	2.10	3.25	1.80	1.70	1.75	1.80	3.15
23	1.80	1.70	2.80	1.9	1.70	2.00	2.50	1.75	1.65	1.85	1.80	2.70
24	1.70	1.70	2.50	1.9	1.70	1.90	2.35	1.70	1.60	1.90	1.80	2.50
25	1.70	1.70	2.50	1.9	1.80	1.90	2.15	1.70	1.60	1.90	1.65	2.30
26	1.70	1.70	2.50	1.9	2.15	2.20	2.10	1.70	1.90	1.90	1.65	2.30
27	2.00	1.70	2.40	1.8	1.80	2.05	3.25	1.60	1.90	1.90	1.70	2.25
28	1.90	3.50	2.40	1.8	1.85	1.90	2.80	1.60	1.90	3.10	1.75	2.20
29	1.80	------	2.40	1.7	2.10	1.95	2.45	1.50	1.85	2.45	1.75	2.20
30	1.80	------	2.40	1.7	2.10	2.10	2.20	1.50	1.80	2.10	1.75	2.20
31	1.80	------	2.40	------	2.00	------	2.20	1.50	------	1.95	------	2.20

SKANEATELES OUTLET AT WILLOW GLEN, N. Y.

A description of the watershed of Skaneateles Lake, including gagings at various points from 1890 to the end of 1901, is given in Water-Supply Paper No. 65, pages 116 to 128. The following table gives the actual flow in the outlet for each day during 1902, as calculated by the Francis formula from readings taken daily at the Willow Glen weir. A table is also given showing the corresponding run-off from the watershed. The amount of diversion for the water supply of Syracuse from July, 1901, to September, 1902, has been furnished by the water department of Syracuse. The diversion added to the actual flow in the outlet comprises the total run-off of the watershed. A table showing these quantities is also given.

Mean daily flow, in second-feet, of Skaneateles outlet at Willow Glen weir, New York.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	72.2	69.6	91.2	74.7	74.7	74.7	80.0	132.5	156.6	129.2	116.2	91.2
2	72.2	69.6	91.2	74.7	74.7	74.7	77.3	135.8	116.2	129.2	116.2	91.2
3	72.2	69.6	91.2	74.7	74.7	77.3	85.5	135.8	116.2	116.2	116.2	91.2
4	72.2	69.6	80.0	74.7	74.7	80.0	80.0	135.8	116.2	116.2	116.2	91.2
5	72.2	69.6	80.0	74.7	74.7	77.3	85.5	135.8	116.2	116.2	116.2	91.2
6	72.2	69.6	80.0	74.7	74.7	74.7	85.5	135.8	116.2	116.2	116.2	91.2
7	72.2	69.6	74.7	74.7	74.7	77.3	80.0	135.8	116.2	116.2	116.2	91.2
8	72.2	69.6	74.7	77.3	74.7	80.0	85.5	135.8	116.2	116.2	116.2	91.2
9	72.2	69.6	80.0	77.3	74.7	77.3	85.5	139.1	116.2	116.2	116.2	91.2
10	72.2	69.6	74.7	80.0	74.7	74.7	91.2	135.8	116.2	116.2	116.2	91.2
11	72.2	69.6	74.7	74.7	74.7	77.3	91.2	135.8	116.2	116.2	116.2	91.2
12	72.2	69.6	77.3	74.7	74.7	74.7	91.2	156.6	116.2	116.2	116.2	91.2
13	72.2	69.6	77.3	74.7	74.7	77.3	94.2	155.6	116.2	116.2	116.2	91.2
14	72.2	69.6	74.7	74.7	74.7	91.2	94.2	156.6	116.2	116.2	116.2	91.2
15	72.2	69.6	74.7	74.7	74.7	80.0	94.2	156.6	116.2	116.2	116.2	80.0
16	72.2	69.6	74.7	74.7	74.7	80.0	94.2	156.6	135.8	116.2	116.2	80.0
17	72.2	69.6	74.7	74.7	74.7	74.7	94.2	156.6	135.8	116.2	116.2	80.0
18	72.2	69.6	74.7	74.7	74.7	74.7	94.2	156.6	160.2	116.2	116.2	80.0
19	72.2	69.6	74.7	74.7	74.7	74.7	97.2	156.6	160.2	116.2	116.2	80.0
20	69.6	69.6	74.7	74.7	74.7	74.7	97.2	156.6	160.2	116.2	116.2	80.0
21	69.6	69.6	74.7	74.7	74.7	74.7	116.2	156.6	129.2	116.2	116.2	80.0
22	69.9	69.6	74.7	74.7	74.7	77.3	116.2	156.6	129.2	116.2	116.2	80.0
23	69.6	69.6	74.7	74.7	74.7	77.3	116.2	156.6	129.2	116.2	116.2	80.0
24	69.6	69.6	74.7	74.7	74.7	77.3	116.2	156.6	129.2	116.2	116.2	80.0
25	69.6	69.6	74.7	74.7	74.7	80.0	116.2	156.6	129.2	116.2	116.2	80.0
26	69.6	69.6	74.7	74.7	74.7	80.0	116.2	156.6	129.2	116.2	116.2	80.0
27	69.6	80.0	74.7	74.7	80.0	77.3	116.2	156.6	129.2	116.2	91.2	80.0
28	69.6	85.5	74.7	74.7	77.3	77.3	129.2	156.6	129.2	116.2	91.2	80.0
29	69.6	.....	74.7	74.7	74.7	77.3	129.2	156.6	129.2	116.2	91.2	80.0
30	69.6	.....	74.7	74.7	74.7	85.5	129.2	156.6	129.2	116.2	91.2	80.0
31	69.6	.....	74.7	.....	74.7	.....	129.2	156.6	.....	116.2	.....	80.0
Average	70.8	70.5	77.1	75.0	75.0	77.7	100.2	149.2	127.5	117.0	112.2	85.0

Estimated monthly discharge of Skaneateles outlet at Willow Glen weir, including diversion for supply of Syracuse.

[Drainage area, 74 square miles.]

Month.	Mean discharge in second-feet.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1901.			
July	142.6	1.93	2.22
August	114.0	1.54	1.78
September	101.6	1.38	1.54
October	117.3	1.58	1.82
November	121.2	1.63	1.82
December	100.3	1.35	1.56
1902.			
January	88.6	1.20	1.38
February	88.5	1.19	1.24
March	96.1	1.30	1.50
April	94.5	1.28	1.43
May	94.5	1.28	1.48
June	95.5	1.29	1.44
July	119.2	1.67	1.93
August	168.5	2.28	2.63
September	146.6	1.98	2.21

Actual run-off of Skaneateles outlet at Willow Glen weir, 1902, in second-feet.

January	70.8	July	100.2
February	70.5	August	149.2
March	77.1	September	127.5
April	75.0	October	117.0
May	75.0	November	112.2
June	77.7	December	85.0

SENECA RIVER AT BALDWINSVILLE, N. Y.

This gaging station was established November 3, 1898, and is described in Water-Supply Papers No. 36, pages 183 to 184, and No. 35, pages 128 to 131, where also the estimated daily discharge and monthly run-off for preceding years may be found.

Mean daily flow, in second-feet, of Seneca River at Baldwinsville, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	3,922	2,755	4,414	6,520	3,738	1,753	2,057	4,078	2,540	2,353	2,441	2,785
2	3,977	1,504	6,017	6,341	3,371	2,717	2,045	4,008	2,628	1,980	2,529	2,576
3	4,030	2,929	8,110	6,080	3,490	2,700	2,148	3,440	2,224	2,098	2,896	2,561
4	3,489	2,227	8,399	6,039	2,540	2,551	1,434	3,983	2,162	2,001	2,770	2,503
5	2,747	2,214	8,920	5,704	3,408	1,717	1,867	3,965	2,138	1,264	2,199	2,511
6	3,656	2,231	9,403	4,700	3,224	1,765	1,799	3,870	1,927	3,498	2,593	2,419
7	3,754	2,312	8,995	5,527	3,223	2,356	2,406	3,676	1,141	2,197	2,574	1,867
8	3,529	2,212	9,051	5,459	3,244	1,710	2,759	3,509	2,403	2,146	2,643	2,723
9	3,776	1,517	8,800	5,314	3,264	2,853	2,931	3,533	1,955	2,180	2,383	2,089
10	3,875	2,590	9,374	5,454	3,126	2,087	3,067	3,207	1,874	2,188	2,834	1,977
11	3,838	2,479	9,349	5,569	2,135	2,443	3,344	3,790	1,809	2,188	2,679	1,816
12	2,965	2,429	9,081	5,468	3,523	2,600	3,268	3,643	1,863	1,398	2,265	1,871
13	3,645	2,656	9,407	4,700	2,963	2,516	2,580	3,589	1,805	2,196	2,424	1,786
14	3,172	2,726	9,237	5,535	2,551	2,270	3,265	3,463	1,213	2,223	2,594	1,251
15	3,023	2,527	9,233	5,409	2,444	1,631	3,311	3,266	2,073	2,133	2,476	1,967
16	2,605	1,979	8,422	5,349	2,567	2,750	3,127	3,276	1,951	2,292	1,946	1,338
17	3,090	2,599	9,330	5,444	2,650	2,780	2,960	3,640	1,921	2,041	2,830	1,795
18	3,045	2,513	9,492	5,240	1,657	2,630	2,770	3,169	1,355	2,748	2,612	1,817
19	2,172	2,655	9,033	5,173	2,799	2,606	2,648	3,074	1,847	1,420	1,932	2,114
20	3,192	2,411	8,802	4,496	2,514	2,533	1,979	3,097	1,709	2,671	2,626	2,061
21	2,986	2,363	8,699	5,454	2,506	2,315	2,695	2,926	1,146	2,353	2,743	1,920
22	3,259	2,030	7,923	4,501	1,662	1,737	2,672	2,825	2,213	2,217	2,292	2,786
23	3,120	1,457	8,217	4,480	2,654	2,641	3,210	2,597	1,841	2,286	2,858	3,356
24	3,092	2,387	8,391	4,318	2,705	2,301	3,041	1,999	1,887	2,331	2,917	2,789
25	3,156	2,417	8,074	4,165	2,075	2,102	3,527	2,977	1,603	2,337	2,597	1,477
26	2,009	2,010	8,936	3,792	3,441	2,209	3,538	2,678	1,545	1,729	1,941	2,848
27	3,499	2,650	7,902	3,474	2,805	2,146	2,974	2,509	1,621	2,432	2,612	2,040
28	2,989	2,822	7,667	4,232	2,785	2,001	3,802	2,370	1,296	2,401	2,887	2,375
29	3,041	.....	7,463	3,868	2,640	1,364	3,931	2,378	1,977	2,475	2,438	3,251
30	2,854	.....	6,516	3,881	2,389	2,123	3,843	2,327	1,785	2,312	2,631	3,091
31	2,854	.....	6,966	.....	2,663	.....	3,795	1,686	.....	2,435	.....	3,048

Estimated monthly discharge of Seneca River at Baldwinsville, N. Y.

[Drainage area, 3,103 square miles.]

Month.	Mean discharge in second-feet.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.			
January	3,279	1.06	1.22
February	2,341	.75	.78
March	8,375	2.70	3.11
April	5,056	1.63	1.82
May	2,788	.90	1.04
June	2,264	.73	.81
July	2,864	.92	1.06
August	3,114	1.00	1.15
September	1,848	.60	.67
October	2,210	.71	.82
November	2,539	.82	.91
December	2,252	.72	.83
The year	3,245	1.04	14.22

ONEIDA RIVER AT OAK ORCHARD, N. Y.

Oneida River forms the outlet of Oneida Lake and joins Seneca River at Three River Point to form Oswego River. Owing to the large surface storage in Oneida Lake and in other lakes and swamps within the watershed, the flow of the stream is unusually regular. There are two low dams in the stream; the one farther downstream at Oak Orchard is a State dam, having a lock at one end; the upper dam at Caughdenoy consists of five W-shaped barriers or eel weirs producing a combined fall of 5 feet during low water. Navigation in the stream is maintained by a lock around one end of the weirs. During extreme high water, the dams at Oak Orchard and Caughdenoy become entirely submerged. There is a dam 8 feet high at Phœnix on Oswego River, 4 miles below the mouth of Oneida River, and it is believed that backwater from this dam produces a smooth surface curve in Oswego and Oneida Rivers from Phœnix to Oneida Lake during extreme freshets. The gaging station was established at Oak Orchard August 30, 1902. The gage readings are taken from a bulkhead of the State lock, upstream from the dam, in order to avoid as much as possible the effect of backwater at ordinary stages, until its extent can be more definitely ascertained. Gage readings are taken twice daily at 7 a. m. and 6.30 p. m. by Arthur McArthur.

Discharge measurements are made at Schroeppel's bridge 0.4 of a mile below the dam. The bridge has five spans. The current is smooth and relatively deep and the stream bed regular and fairly permanent. The bridge spans are subdivided into smaller sections during low water by abandoned bridge piers underneath. A current-meter discharge measurement by R. E. Horton, July 22, 1902, gave the following results: Gage height, 2.75 feet; discharge, 3,307 second-feet.

Mean daily gage height, in feet, of Oneida River at Oak Orchard, N. Y., for 1902.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.13	4.50	4.05	4.10	17	.....	4.40	4.50	4.00	4.00
2	.....	4.13	4.53	4.00	4.10	18	.....	4.40	4.50	3.95	3.90
3	.....	4.13	4.50	4.05	4.05	19	.....	4.40	4.45	4.05	3.85
4	.....	4.23	4.50	4.05	4.00	20	.....	4.40	4.40	4.05	3.70
5	.....	4.33	4.45	4.05	4.05	21	.....	4.50	4.40	4.15	3.60
6	.....	4.20	4.55	4.05	4.10	22	.....	4.58	4.38	4.20	3.55
7	.....	4.20	4.50	4.08	4.10	23	.....	4.58	4.33	4.15	3.40
8	.....	4.20	4.50	4.00	4.40	24	.....	4.50	4.30	4.10	3.25
9	.....	4.20	4.40	4.05	4.20	25	.....	4.50	4.40	4.10	3.20
10	.....	4.25	4.40	4.10	4.05	26	.....	4.50	4.23	4.10	3.10
11	.....	4.30	4.40	4.05	4.05	27	.....	4.50	4.35	4.15	3.20
12	.....	4.30	4.40	4.08	4.00	28	.....	4.60	4.30	4.20	3.20
13	.....	4.30	4.45	4.10	4.00	29	.....	4.63	4.30	4.15	3.15
14	.....	4.40	4.55	4.05	4.00	30	4.00	4.58	4.10	4.15	3.15
15	.....	4.40	4.50	4.10	4.00	31	4.05	.....	4.10	.....	3.25
16	.....	4.40	4.53	4.10	4.00						

OSWEGO RIVER AT FULTON, N. Y.

During the freshet of March, 1902, a series of observations of the depth on crest of the lower water-power dam on Oswego River at Fulton was taken by O. C. Breed, C. E. The dam has a horizontal crest 521 feet in length. The discharge has been calculated by the weir formula, using coefficients adapted to the cross section in question, selected from the United States deep waterways experiments on dams at Cornell University. On days when water wheels were running at the time of the gage height observations, the amount of water carried around the dam in headraces has been added to the flow from the spillway, the proper allowance having been determined by observations during low water of 1900. The drainage area above the dam is 4,916 square miles.

Discharge of Oswego River at Fulton, N. Y.

Date.	Time.	Discharge.	Run-off.
1902.		*Second-feet.*	*Second-feet per square mile.*
March 2	9 a. m.	[a] 10,200	2.07
Do	5 p. m.	13,700	3.15
March 3	7 a. m.	19,200	3.90
Do	(?) p. m.	19,700	4.00
March 9	9 a. m.	18,000	3.66
March 10	10 a. m.	18,700	3.80
March 13	12 m.	21,400	4.35
March 16	10 a. m.	20,215	4.11
March 17	8 a. m.	21,100	4.29
March 23	10 a. m.	19,400	3.94
March 30	9 a. m.	15,500	3.15

[a] Ice went off from pond above dam.

OSWEGO RIVER ABOVE MINETTO, N. Y.

This gaging station is described and daily elevation of water surface for 1900 and 1901 is given in Water-Supply Paper No. 65, pages 134 to 136. The cable way from which discharge measurements are made is situated three-fifths of a mile below Battle Island dam. The gage, from which observations are taken twice each day by H. L. Woodcock, is 2,930 feet upstream from the cable.

Mean daily flow, in second-feet, of Oswego River above Minetto, N. Y.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1900.					1900.				
1	.....	1,620	2,280	6,080	17	1,998	2,136	2,632	10,020
2	.....	1,620	2,280	5,819	18	1,620	2,040	2,472	10,748
3	.....	1,620	1,552	6,448	19	1,518	2,040	2,424	10,332
4	.....	1,704	1,552	6,448	20	1,662	2,472	2,968	10,228
5	.....	1,704	2,184	10,644	21	1,746	1,280	2,968	10,124
6	.....	1,704	2,424	12,477	22	1,704	1,830	.....	10,228
7	.....	1,280	2,520	12,477	23	1,956	2,328	.....	10,020
8	.....	1,348	2,472	12,477	24	1,662	1,704	.....	10,124
9	.....	1,914	2,376	12,150	25	1,314	1,704	.....	9,6 8
10	.....	1,704	2,280	11,714	26	1,518	1,746	2,688	9,814
11	.....	1,872	1,746	11,496	27	1,620	1,746	3,656	7,198
12	.....	1,998	2,688	11,060	28	1,586	1,320	4,586	6,632
13	.....	2,040	2,576	11,060	29	1,586	2,136	5,297	6,356
14	1,586	1,662	2,632	10,748	30	1,552	2,232	6,264	6,172
15	1,586	1,746	2,632	9,917	31	.....	2,376	.....	4,898
16	1,745	1,914	2,576	9,917					

lean daily flow, in second-feet, of Oswego River above Minetto, N. Y.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	5,297	6,540	2,856	18,190	17,475	7,792	6,724	2,856	2,744	2,968	3,080	4,508
2	4,820	5,906	3,336	18,080	16,990	7,792	6,540	2,688	2,744	2,856	3,272	4,359
3	4,586	5,210	3,862	18,550	16,174	7,792	6,264	2,688	2,856	2,912	3,024	4,288
4	4,430	4,976	4,075	18,190	15,832	7,297	6,080	2,472	3,024	3,144	2,968	4,288
5	5,132	4,820	3,862	18,190	15,377	6,816	5,906	2,632	3,144	3,144	2,856	4,359
6	4,217	4,742	3,656	18,300	14,925	6,540	5,732	2,744	3,144	2,744	3,024	4,288
7	4,359	4,508	3,592	18,080	14,812	7,891	5,645	3,272	3,080	2,856	3,080	4,217
8	4,508	4,508	4,004	18,425	14,360	6,080	5,471	2,912	3,208	2,912	3,024	4,586
9	5,906	4,075	4,288	18,190	13,912	6,080	5,471	2,744	3,400	2,912	2,968	5,210
10	5,384	2,472	4,508	18,080	13,464	6,264	5,471	2,688	3,336	3,024	3,272	5,297
11	5,993	3,336	4,508	18,550	12,804	6,264	4,976	2,688	3,272	3,208	3,400	5,645
12	6,172	3,464	4,820	18,550	12,368	6,356	5,054	3,080	3,336	2,912	3,336	6,264
13	6,448	3,336	4,898	18,300	12,041	6,632	5,054	2,688	3,080	2,576	3,464	6,908
14	6,540	3,080	5,819	17,830	11,714	7,099	4,146	2,688	3,024	2,968	3,464	11,496
15	6,724	3,208	5,993	17,715	11,387	7,297	4,217	2,856	2,632	3,144	3,400	11,387
16	7,099	3,208	6,172	17,830	11,169	7,396	4,075	2,800	3,400	3,144	3,791	13,022
17	5,993	3,080	6,540	17,955	10,540	7,594	3,933	2,800	3,272	3,208	3,272	13,240
18	5,471	2,912	6,816	18,080	9,608	7,000	3,656	2,800	3,080	3,144	3,336	13,131
19	5,297	2,800	9,505	18,675	7,297	6,816	3,528	2,688	3,272	3,272	3,272	13,022
20	5,054	2,800	10,748	19,355	9,196	6,816	3,400	2,520	3,336	2,912	3,336	12,150
21	4,508	2,912	13,688	20,066	8,790	6,816	3,144	2,520	3,528	3,272	3,464	11,496
22	5,645	2,856	12,368	20,066	7,099	6,816	3,400	2,520	2,968	3,272	3,464	11,605
23	5,906	2,968	13,688	19,829	6,908	6,816	3,336	2,688	3,336	4,288	3,592	11,823
24	5,645	3,080	13,688	19,948	6,908	7,000	3,400	2,744	2,968	2,912	4,146	12,259
25	5,297	3,208	17,955	20,036	6,816	7,099	3,208	2,632	3,080	4,288	4,359	12,368
26	5,132	2,800	19,118	19,829	6,816	6,816	3,272	3,144	2,744	3,208	4,508	12,586
27	4,820	3,144	18,800	19,829	7,000	7,891	3,272	3,024	2,968	3,024	5,132	12,477
28	5,558	2,744	20,540	19,829	7,000	13,576	3,400	3,272	3,464	3,080	5,297	11,932
29	5,819	.....	20,777	19,000	7,198	7,198	3,400	3,144	2,632	3,080	5,645	12,695
30	5,906	.....	20,303	18,080	7,198	6,816	3,144	3,024	2,856	3,208	5,819	11,823
31	6,080	.....	19,711	.....	6,816	.....	2,968	3,208	.....	3,080	.....	11,169

Mean daily flow, in second-feet, of Oswego River above Minetto, N. Y.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	10,956	7,396	8,690	15,718	8,890	6,080	7,396	8,390	4,742	3,656	5,601	5,514
2	10,124	7,297	14,699	15,151	8,790	6,172	7,891	7,297	4,742	3,933	5,732	5,297
3	10,644	7,198	19,237	14,812	8,690	6,080	8,290	8,290	4,586	4,004	5,732	5,210
4	10,332	7,396	19,000	14,586	8,190	5,993	8,290	8,190	4,586	4,288	5,732	5,210
5	10,020	7,297	18,900	14,473	8,390	5,993	8,590	8,090	4,430	4,004	5,732	3,614
6	10,020	7,099	19,237	14,024	8,090	5,993	8,290	8,090	4,288	4,146	5,601	5,054
7	10,124	5,210	19,000	14,248	7,792	5,906	8,790	8,290	1,416	4,146	5,732	4,586
8	10,228	7,000	18,550	13,912	7,396	5,732	8,790	7,891	4,004	4,288	5,906	4,820
9	10,332	6,908	19,000	13,800	6,908	6,264	8,690	7,990	1,348	4,288	4,508	4,838
10	10,020	6,908	19,000	13,576	6,908	6,356	8,690	8,290	1,620	4,288	5,861	4,976
11	9,711	6,632	19,355	13,464	6,448	6,448	8,590	8,690	1,586	4,288	5,906	5,132
12	9,917	6,816	19,829	13,240	6,724	6,540	8,490	8,590	1,518	4,004	5,732	5,210
13	9,814	6,908	21,518	13,131	6,632	6,816	8,490	7,990	1,620	4,146	5,732	5,210
14	9,711	6,724	21,518	12,913	6,540	6,540	8,290	7,990	1,484	4,288	5,558	5,384
15	8,990	6,540	21,400	12,804	6,356	6,264	8,090	7,693	1,552	4,288	5,471	5,384
16	8,790	6,540	19,948	12,695	6,172	6,448	7,792	7,693	1,552	4,586	4,898	5,558
17	8,390	6,724	20,066	12,695	5,906	6,540	7,693	7,198	1,620	4,742	5,732	5,645
18	8,390	6,724	20,540	12,477	5,132	6,356	8,290	7,396	3,862	4,742	5,906	5,558
19	8,190	6,540	20,185	12,041	5,558	6,264	6,816	6,632	3,933	4,430	6,034	5,558
20	7,495	5,054	20,303	10,852	5,132	6,080	7,297	6,540	3,862	4,586	6,080	5,384
21	6,816	4,820	19,829	11,278	4,898	6,172	7,099	6,264	3,400	4,288	6,080	4,976
22	7,396	4,430	19,711	11,060	4,820	5,906	7,099	5,993	3,464	4,664	6,218	4,898
23	5,819	4,430	19,000	10,748	4,586	6,080	7,495	5,906	3,464	5,210	5,993	5,384
24	7,891	4,508	18,425	10,436	4,586	6,172	7,891	5,645	3,464	5,384	6,264	5,471
25	7,693	4,586	17,955	10,228	4,359	6,264	7,792	5,645	3,336	5,558	6,264	5,384
26	7,594	4,586	17,600	10,020	6,632	6,356	8,090	5,558	3,336	5,558	6,264	5,210
27	7,297	4,898	17,230	8,690	6,540	6,172	8,190	4,976	3,336	5,558	6,172	5,210
28	7,099	7,495	16,516	9,093	6,632	5,993	8,290	5,210	2,968	5,558	6,034	4,586
29	7,297	.....	16,060	9,093	6,724	6,080	8,290	5,054	3,272	5,732	5,819	4,586
30	5,906	.....	16,402	9,093	6,816	6,448	8,090	5,054	3,336	5,732	5,645	4,820
31	7,396	.....	16,060	.....	6,356	.....	7,891	4,430	.....	5,732	.....	4,898

Estimated monthly discharge of Oswego River above Minetto, N. Y.

[Drainage area, 4,990 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1900.	*Sec.-ft.*		
September	1,644	0.32	0.36
October	1,823	.36	.41
November	2,797	.56	.62
December	9,465	1.89	2.18
1901.			
January	5,475	1.09	1.26
February	3,667	.73	.76
March	9,499	1.90	2.19
April	18,721	3.74	4.17
May	10,967	2.19	2.52
June	7,215	1.44	1.61
July	4,428	.88	1.01
August	2,813	.56	.64
September	3,097	.62	.69
October	3,118	.62	.84
November	3,668	.73	.81
December	9,158	1.83	2.11
The year	6,819	1.36	18.61
1902.			
January	8,722	1.64	1.89
February	6,238	1.25	1.31
March	18,540	3.71	4.28
April	12,345	2.47	2.76
May	5,567	1.31	1.51
June	6,216	1.24	1.38
July	8,056	1.61	1.86
August	6,998	1.40	1.61
September	3,057	.61	.68
October	4,648	1.16	1.08
November	5,797	.94	1.29
December	5,116	1.02	1.18
The year	7,608	1.53	20.83

Current-meter discharge measurements of Oswego River at cable station.

Date.	Hydrographer.	Elevation of water surface.	Discharge.
1902.		*Feet.*	*Sec.-ft.*
August 19	E. C. Murphy	87.34	6,562
Do	do	87.44	6,999
July 21	R. E. Horton	87.87	8,445
July 9	E. C. Murphy	88.37	8,585
Do	do	88.41	9,019
July 8	do	88.42	8,634
Do	do	88.44	8,601
April 1	do	91.52	15,653
March 31	do	91.77	15,982

A rating curve for the cross section at the cable station has been plotted from the above discharge measurements and those previously made and the daily discharge and run-off calculated as given in the accompanying tables. No allowance for water diverted to Oswego Canal has been made. It is the intention, however, to make a series of measurements of the flow in this canal.

March 13 at 5 p. m. the stream reached an elevation of water surface of 94.45 corresponding to a discharge of about 22,500 second-feet, or 4.5 second-feet per square mile. The ice flowed out of the level in which the cable is situated March 7.

OSWEGO RIVER AT HIGH DAM, NEW YORK.

This gaging station is described and the mean daily discharge and run-off for 1897 to 1901, inclusive, are given in Water-Supply Paper No. 65, pages 137 to 139. Owing to the irregular and uncertain condition of flashboards on the dam it has been impossible to calculate the discharge for the year 1902 in a reliable manner, and the record is withheld until additional information can be secured. A current-meter discharge measurement of the flow in the headrace at the dam was made July 21, 1902; all water wheels were running and the measured flow was 650 second-feet, the effective head on the turbines being 13 feet.

ST. LAWRENCE RIVER DRAINAGE BASIN.

RAQUETTE RIVER AT HANNAWA FALLS, N. Y.

The watershed of this stream is described in Water-Supply Paper No. 65, pages 36 to 38. A gaging record at the dam of the Hannawa Falls Water Power Company has been kept, beginning September 1, 1902. The record includes the depth flowing over the crest of the dam, the number of hours run, and width of gate opening of each of the two pairs of water wheels in use. The nominal working head is 85 feet. A record of the height of the water in the forebay and also in the tailrace is kept, from which the variations in the effective head can be determined for the purpose of calculating the discharge through the turbines. The height of opening of the waste gates used for log sluicing and freshet control at the dam, and of the overflow gate at the entrance to the power canal is also recorded.

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

Richelieu River, the outlet of Lake Champlain, leaves the lake at Rouse Point near the international boundary between New York and Canada. A record of the daily stage of the lake at its outlet has been kept since January 1, 1875. Data for reducing the observed elevation of water surface to equivalent discharge in the outlet were obtained by the United States Board of Engineers on Deep Waterways at the Chambly dam in 1898. The resulting calculated monthly mean flow and other discharge data are to be found in Water-Supply Paper No. 65, pages 38 to 42. Through the courtesy of Capt. Harry Taylor, U. S. Army, the gage readings taken daily are reported each week to the United States Geological Survey.

The gage readings are taken by measuring with a rod the depth of water on the base of the scarp wall of the north bastion of Fort Montgomery about 3 feet from the angle with the east curtain of the fort. The elevation of this datum is 95 feet above tide. The gage readings are referred to a datum 1.5 feet lower; 1.5 feet being added to the measured depth to obtain the recorded gage height.[a] During winter, when the lake is frozen over, the gage height is measured in an open well, which does not freeze, situated within the fort inclosure.

[a] The gage zero elevation, 93.50 above mean tide at New York, is the lowest recorded stage of the lake.

Mean daily flow, in second-feet, of Richelieu River at Fort Montgomery, N.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1902.												
1	13,240	11,460	10,610	37,400	26,440	22,180	18,660	14,740	11,630	9,080	10,270	10,5
2	13,980	11,460	12,160	36,700	26,180	21,700	18,450	15,120	11,290	8,570	10,950	10,1
3	13,240	11,460	15,880	36,350	26,440	21,040	18,660	14,930	11,290	8,740	11,290	10,6
4	13,240	11,460	19,500	36,000	26,180	17,820	18,240	14,360	10,440	8,400	10,950	9,7
5	13,600	11,630	21,260	35,340	25,920	21,260	18,030	14,170	10,270	8,910	10,950	9,4
6	13,240	11,460	22,180	35,010	25,140	21,040	17,610	14,550	10,610	8,570	11,980	9,9
7	13,240	11,460	22,660	34,350	26,700	21,480	18,450	14,360	11,290	9,420	10,850	10,4
8	12,880	11,290	22,660	33,360	25,140	20,160	17,820	13,980	10,440	8,570	10,440	10,1
9	12,880	11,290	23,140	31,770	24,100	20,380	17,400	14,170	10,950	8,400	10,610	9,7
10	12,700	11,290	23,380	32,390	23,380	20,380	16,640	14,170	10,100	8,400	10,100	10,9
11	12,520	11,120	23,620	32,390	23,620	20,600	16,260	14,360	10,780	9,420	10,270	9,4
12	12,520	11,120	23,620	32,080	23,140	20,160	17,400	13,790	10,270	8,060	12,160	9,4
13	12,700	10,950	25,140	32,390	22,660	20,380	16,450	13,600	.....	9,080	10,440	9,4
14	12,340	10,950	27,860	32,080	21,700	19,940	16,070	13,790	9,930	8,230	10,100	9,5
15	12,520	10,950	29,910	31,770	21,700	20,820	15,880	13,420	10,270	8,910	10,950	9,4
16	12,340	10,780	.....	31,150	21,700	20,380	15,310	13,420	10,100	8,060	10,440	13,7
17	11,980	10,780	31,460	30,220	21,040	21,040	16,070	13,060	10,100	8,230	10,440	10,61
18	12,160	10,780	34,020	29,910	20,600	21,260	15,120	12,880	12,160	8,570	11,290	9,5
19	11,630	10,610	35,010	29,910	20,380	21,700	15,310	12,880	9,930	8,570	11,120	9,9
20	11,630	10,610	35,340	29,310	19,500	21,040	15,120	12,700	9,590	8,400	10,780	9,5
21	11,460	10,440	35,340	28,440	19,720	21,040	15,500	13,600	9,930	7,890	11,120	10,44
22	11,290	10,270	36,000	29,020	19,290	21,040	15,120	12,880	10,100	8,570	11,120	9,9
23	11,630	10,270	36,700	28,440	18,870	20,380	15,310	12,340	9,930	7,550	10,270	10,27
24	11,460	10,270	37,050	27,860	18,240	20,380	15,310	12,160	9,080	10,100	11,290	10,61
25	11,460	10,100	37,050	27,570	18,660	19,940	15,500	11,980	9,250	7,720	10,100	11,12
26	11,630	10,100	36,700	29,020	18,870	20,160	15,690	12,340	9,930	8,570	10,100	11,29
27	11,630	10,100	37,400	27,280	18,870	19,500	15,690	11,980	9,420	9,250	10,950	11,29
28	11,460	10,100	37,050	26,700	19,940	19,080	15,120	11,800	9,250	8,060	10,440	11,29
29	11,630	.....	36,350	26,700	21,940	18,870	14,930	11,980	8,740	8,570	10,780	11,46
30	11,460	.....	36,000	27,570	21,040	19,080	14,740	11,800	8,910	9,760	10,780	11,29
31	11,460	.....	37,050	.....	21,700	.....	14,740	11,460	.....	9,760	.....	11,29
Mean	12,295	10,877	28,700	31,282	22,212	20,474	16,338	13,315	10,206	8,657	10,777	10,40

Estimated monthly discharge of Lake Champlain drainage basin at Chambly, Province of Quebec.

[Drainage area, 7,750 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Second-feet.*		
January	12,295	1.59	1.83
February	10,877	1.40	1.42
March	28,700	3.70	4.27
April	31,282	4.04	4.51
May	22,212	2.87	3.31
June	20,474	2.64	2.95
July	16,338	2.11	2.43
August	13,315	1.72	1.98
September	10,206	1.32	1.47
October	8,657	1.12	1.29
November	10,777	1.39	1.55
December	10,405	1.34	1.54
The year	16,299	2.10	28.55

MOHAWK RIVER DRAINAGE BASIN.

ORISKANY CREEK NEAR ORISKANY, N. Y.

This gaging station was established at Wood road bridge, 1 mile above Oriskany village, June 25, 1901, taking the place of a station previously maintained at the New York State dam at Oriskany. Both stations are described and records given for preceding years in Water-Supply Paper No. 65, pages 145 to 149.

Current-meter discharge measurements of Oriskany Creek at Wood road bridge.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
September 9	C. C. Covert	2.00	275
March 3	R. E. Horton	5.12	2,125

March 1, 1902, the calculated discharge over the Waterbury dam at Oriskany was 5,200 second-feet, the gage reading at Wood road bridge being 8.26 feet. This was taken after the ice floe passed downstream.

The calculated maximum discharge of Oriskany Creek during the freshet of December 15–16, 1901, was 7,350 second-feet, or 51.4 second-feet per square mile.

Mean daily gage height, in feet, of Oriskany Creek near Oriskany, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	3.70	3.30	8.00	2.60	1.85	1.80	2.50	2.50	1.50	2.50	2.50	2.30
2	4.40	3.00	7.00	2.90	1.80	1.60	2.10	2.90	1.95	2.70	2.35	2.15
3	4.70	3.00	6.00	3.10	2.05	2.15	2.70	2.40	2.20	2.05	2.35	2.45
4	4.45	3.50	4.80	2.75	2.40	3.05	3.30	2.50	2.75	1.70	2.35	2.70
5	4.00	3.40	3.45	2.70	1.90	2.50	4.30	2.00	2.15	1.70	2.20	2.30
6	3.90	3.20	2.95	2.60	1.90	2.05	3.60	3.70	1.70	2.20	2.55	2.50
7	3.85	3.05	2.90	2.50	1.90	2.00	3.50	3.10	1.95	2.30	2.30	3.40
8	3.80	3.00	2.70	2.40	1.80	2.40	3.20	3.25	1.65	2.15	2.00	3.75
9	3.60	3.00	2.60	2.55	1.80	3.10	2.90	2.40	1.80	2.00	2.00	4.65
10	3.40	2.80	2.75	3.25	1.75	3.50	3.75	2.05	2.20	1.80	1.90	4.50
11	3.60	2.80	3.00	2.70	1.65	3.10	2.80	2.45	1.90	1.65	2.15	4.60
12	3.15	3.10	6.10	2.45	1.60	2.70	2.40	2.25	1.70	1.65	2.30	4.60
13	2.80	3.10	6.05	2.70	1.60	2.20	2.00	2.00	1.40	1.80	2.35	4.60
14	2.60	3.10	4.90	2.65	1.60	2.25	1.80	2.00	1.40	1.80	2.20	4.50
15	2.60	3.10	3.90	2.40	1.60	2.25	2.70	1.80	1.60	1.65	2.05	4.50
16	2.60	3.10	4.15	2.40	1.20	2.00	2.60	1.60	1.60	1.65	1.95	4.90
17	3.00	3.10	5.80	2.40	1.20	1.90	2.25	1.75	1.60	1.60	2.05	5.70
18	2.70	3.10	4.70	2.30	1.40	1.85	1.90	2.10	1.70	1.60	2.25	5.30
19	2.60	3.10	4.00	2.20	1.50	2.00	2.35	2.50	1.60	2.25	2.10	4.80
20	2.60	3.10	3.05	2.20	1.85	1.90	2.50	2.10	1.40	2.10	1.80	4.40
21	2.80	3.15	3.20	2.20	1.60	2.00	4.00	2.10	1.55	2.20	1.95	4.15
22	3.70	3.20	3.15	2.10	1.40	1.90	3.90	2.50	1.60	1.95	1.80	4.90
23	3.45	3.20	3.20	2.00	1.85	2.00	3.25	2.70	1.50	2.20	1.70	3.95
24	3.20	3.20	3.55	1.90	2.00	2.00	2.80	2.15	1.60	2.15	2.05	3.40
25	3.20	3.40	3.00	1.90	1.90	1.80	2.55	1.90	1.60	1.90	2.20	3.90
26	3.25	3.45	2.80	1.90	2.90	2.10	2.25	1.60	1.90	1.80	2.30	3.80
27	3.65	3.90	2.70	1.90	2.85	2.00	1.90	1.45	1.50	2.00	2.55	3.90
28	3.60	5.00	2.70	1.90	2.75	1.85	2.60	1.85	1.60	5.10	2.80	3.85
29	3.60	.....	3.05	1.90	2.80	1.85	2.70	1.70	1.95	3.50	2.45	4.00
30	3.50	.....	2.90	2.00	3.20	2.25	2.35	1.55	2.20	2.90	2.20	3.95
31	3.40	.....	2.70	.....	2.70	.....	2.30	1.45	.....	2.90	.....	3.80

MOHAWK RIVER AT UTICA, N. Y.

This gaging station is described in Water-Supply Paper No. 65, pages 151 to 153. March 1 and 2, 1902, a freshet occurred, accompanied by the breaking up of the winter's ice accumulation, which raised the water to elevation 407.14, the estimated discharge being 17,200 second-feet from the drainage area of 500 square miles, or 34.4 second-feet per square mile.

Mean daily flow, in second-feet, of Mohawk River at Utica, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	536	283	11,750	.....	1,972	.....	1,618	408	383	589	1,585	870
2	631	484	11,150	1,264	771	.....	1,972	1,900	383	743	743	785
3	617	420	10,300	1,652	562	.....	2,009	.....	270	575	743	960
4	484	420	6,800	1,295	.....	.....	.....	433	270	484	673	2,085
5	.....	445	4,520	1,110	617	1,900	3,542	1,140	445	445	659	1,486
6	510	445	3,840	1,140	523	743	.....	1,295	.....	510	645	687
7	471	420	1,990	1,020	523	510	.....	2,200	.....	945	1,080	715
8	471	420	1,810	900	562	673	2,688	1,520	.....	1,233	743	900
9	471	433	1,653	900	370	1,050	1,619	1,520	235	729	575	813
10	433	420	1,155	2,085	320	631	1,828	.....	1,232	484	458	701
11	433	701	.....	1,864	.....	1,775	1,810	715	645	458	589	841
12	395	420	3,200	1,186	270	1,065	870	1,536	[a]69	458	645	729
13	345	420	5,895	1,110	.....	1,264	701	757	370	484	1,050	.....
14	358	420	4,700	1,005	320	1,080	645	617	345	471	757	549
15	408	445	3,542	870	295	.....	930	523	715	471	631	617
16	408	445	3,060	729	295	.....	1,810	484	510	458	631	645
17	283	433	4,640	659	220	549	1,586	.....	484	383	562	.....
18	370	433	.....	589	208	549	870	471	562	395	562	2,661
19	370	433	3,025	497	308	.....	701	484	562	.....	589	2,920
20	370	433	2,085	458	433	484	2,085	523	562	1,900	701	2,850
21	395	433	1,295	484	283	.....	2,767	484	471	.....	603	2,066
22	420	445	1,390	433	245	.....	3,684	484	458	.....	645	2,280
23	1,050	445	1,864	458	245	900	3,200	484	484	.....	975	3,390
24	1,050	471	1,705	.....	585	549	1,825	.....	220	.....	900	.....
25	562	471	1,342	270	.....	484	1,005	484	220	.....	799	2,520
26	673	538	1,140	383	1,520	960	813	395	245	562	617	1,486
27	729	1,828	1,050	536	2,085	2,180	.....	471	245	631	.....	1,020
28	729	.....	1,020	562	1,035	1,536	1,687	420	320	3,200	2,085	.....
29	785	.....	1,342	270	1,110	.....	1,653	383	1,080	4,100	1,232	813
30	673	.....	2,240	1,520	1,202	1,569	715	383	743	3,095	855	757
31	510	.....	1,279	.....	701	.....	433	383	.....	1,583	.....	799

[a] Below limit of rating curve.

Current-meter discharge measurements of Mohawk River at Utica, N. Y.

Date.	Elevation of water surface.	Discharge.	Hydrographer.
1902.	*Feet.*	*Sec.-ft.*	
March 4	405.96	11,678	R. E. Horton.
July 1	398.63	2,071	H. R. Beebe.
July 3	400.43	2,589	Do.
July 7	403.11	4,391	Do.
August 22	395.17	454	C. C. Covert.
December 10	395.97	[a] 681	R. E. Horton.
December 11	396.47	[a] 817	C. C. Covert.

[a] Measured through 6 inches of ice at Schuyler street bridge, Utica, N. Y.

Estimated monthly discharge of Mohawk River at Utica, N. Y.

[Drainage area, 500 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Second-feet.*		
January	531	1.06	1.22
February	496	.99	1.03
March	3,475	6.95	7.99
April	902	1.80	2.01
May	651	1.30	1.50
June	1,023	2.04	2.28
July	1,669	3.33	3.84
August	774	1.54	1.78
September	457	.91	1.01
October	1,016	2.03	2.34
November	805	1.61	1.80
December	1,368	2.74	3.16
The year	1,097	2.19	29.96

REELS CREEK NEAR UTICA, N. Y.

Reels Creek is tributary to the Mohawk River from the north at Utica, N. Y. Its drainage basin is shown on the Utica sheet of the United States Geological Survey; the watershed is hilly. The stream receives numerous lateral tributaries, draining deep ravines and entering the main stream at short intervals in a manner conducive to the rapid carrying off of surface waters. The watershed is mostly pasture land, some timber, and a small percentage of cultivated fields. A deep soil of clay and gravel is underlain with loose shale. There is very little swamp or "spring ground." Tributaries which head in the gravel of the serrated hillsides as a rule become dry at times. Others, which have shale beds, are fed by springs of percolating water which has passed through the glacial drift to the rock horizon.

In 1900 a masonry intake dam was constructed on the stream 4 miles north of Utica by the Consolidated Water Company, of Utica. Beginning January 1, 1901, a record has been kept of the wastage at this dam, as well as the diversion for water-supply purposes whenever water has been taken. A record of the precipitation on the watershed has been kept at Deerfield reservoir, 1 mile downstream from the intake dam. The records of rainfall and stream flow have been furnished by William S. Bacot, civil engineer.

The intake dam has a spillway 119.7 feet long, 6 feet in width, and

a slope downward on the upstream side of 0.75 foot. The water falls into a masonry pool. In order to determine the low-water flow more accurately than could be done by calculation of the discharge over the rough masonry spillway crest, a standard thin-edged weir was constructed on the overflow wall of the water cushion. The weir has a crest 29.02 feet long, with two complete end contractions. The crest is of steel, set perfectly level, and readings of depth are made on a hook gage set in a stilling box 6 feet upstream from the weir.

A calculation of the discharge over the main spillway of the intake dam under low heads was made by running constant volumes of water over both the spillway and weir, corresponding to different depths on the spillway, and the data so obtained have been used in reducing the observations taken before the weir was constructed. During the period from June 1, 1901, to May 1, 1902, the gage was read as a rule only once a week. During the remainder of the record the observations have been taken daily.

There are no dams, ponds, or storage reservoirs above the point of gaging, and the stream receives very little surface contamination. The records are of interest in that they show the natural regimen of a small stream of the northern plateau, as well as the sequence of rainfall and of run-off in a torrential drainage basin.

The basin formed by the intake dam has a storage capacity of 17,000,000 gallons. It is practically always filled and exerts very little influence on the rate of discharge of storm waters. The greatest known freshet in the stream occurred in August, 1898. Data are not available for the calculation of the discharge. It is known to have greatly exceeded any freshet which has occurred while the record has been kept. It is probable that the record does not show the maximum discharge on March 1 of 1902, as the daily gage reading on that date was taken before the flood reached its highest stage. The minimum flow, since the installment of the gaging weir, occurred August 30 to September 1, 1902, inclusive, and shows a discharge of 0.4 second-foot from the drainage area of 4.5 square miles, or 0.089 second-foot per square mile. The drainage area of the stream above its confluence with Mohawk River is 8.4 square miles.

Measurements of the flow of Reels Creek at a point 200 feet upstream from the intake dam, made during 1902, gave the following results:

Discharge measurements of Reels Creek.

Date.	Time.	Discharge.
1902.		*Second-feet.*
April 26	P. M.	2.4
May 5	P. M.	9.7
May 14	A. M.	1.2

Surface floats were used, and owing to the low velocity and small volume of discharge, they were run through a short section (35 feet.)

In this connection may be given the data relative to certain other small watersheds.

The maximum discharge of Ballou Creek, which enters Mohawk River at Utica from the south, is calculated from the observed depth on the spillway and waste gate of the No. 4 reservoir of the Utica Waterworks Company, at 181 second-feet or 130 second-feet per square mile from the tributary drainage of 1.4 square miles above point of gaging. This freshet was caused by a very heavy thunder storm, which raised the water in the reservoir several feet in an hour.

Mean daily flow, in second-feet, of Reels Creek near Utica, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	1.75	1.75	1.30	1.75	1.75	128.40						
2	1.75	1.75	1.30	15.30	1.75						1.30	
3	1.75	1.75	1.30	35.50	1.75			6.00				
4	1.75	1.30	1.30	38.00	1.30							
5	1.75	1.30	1.30	27.00	1.30					1.75		
6	1.75	1.30	1.30	6.69	1.30		37.50					
7	1.75	1.30	1.30	19.50	1.30				32.00			1.75
8	1.75	1.30	1.30	44.59	1.30	209.10						
9	102.50	1.30	3.12	22.31	1.30						30.50	
10	62.00	1.30	4.38	15.30	2.48			15.30				
11	1.75	1.30	1.75	12.00	6.83							3.44
12	1.75	1.30	1.75	12.00	62.68					1.30		2.81
13	1.75	1.30	1.75	4.50	34.72		9.00					2.19
14	1.75	1.30	1.75	2.48	6.70				1.75			124.50
15	1.75	1.30	1.75	2.48	4.41	9.00						
16	1.75	1.30	3.41	2.48	1.75						1.75	
17	1.75	1.30	2.50	2.48	1.30			4.50				
18	1.75	(a)	3.12	2.48	55.80							
19	1.75		3.44	5.45	3.40					15.30		
20	1.75		4.06	4.87	2.48		1.75					
21	1.75		49.90	1.75	2.48				1.30			2.48
22	1.75		22.80	2.48	1.75	2.48						
23	1.75		12.00	6.00	15.30						1.30	
24	1.30		15.25	2.48	1.75			132.40				
25	1.30		14.62	55.80	1.75					1.30		
26	1.30		10.88	1.75	1.75							
27	1.30		43.55	1.75	2.48		1.30					
28	1.30		24.50	1.75	2.48				1.30			1.30
29	1.30		7.70	1.75	15.30	1.75						4.69
30	1.30		2.48	1.75	15.30						1.30	5.00
31	1.30		1.75		9.00			62.00				
Mean	6.83	1.38	8.02	11.81	8.55	70.15	12.39	44.04	9.09	4.91	7.23	16.40

[a] Record interrupted.

Mean daily flow, in second-feet, of Reels Creek near Utica, N. Y.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	.....	1.30	254.70	.....	4.50	10.3	42.5	.9	.4	9.10	3.90	3.90
2	.....	.....	167.00	.....	1.30	1.6	2.0	.8	2.2	9.10	2.90	5.40
3	.....	.....	92.00	.....	13.60	103.0	128.5	1.5	1.2	7.80	2.60	6.00
4	1.30	.....	.....	.....	9.00	42.5	20.6	1.4	2.4	2.90	2.20	3.90
5	.....	.....	.....	30.50	13.60	8.4	206.7	1.2	1.5	1.80	2.20	2.20
6	.....	.....	.....	.....	12.00	1.1	86.8	5.4	.9	28.50	3.90	2.20
7	.....	.....	.....	2.48	9.00	0.9	30.6	9.1	15.4	3.90	2.20	2.40
8	.....	1.75	4.50	.....	4.50	26.1	15.4	21.6	2.2	28.50	2.20	5.40
9	.....	.....	.....	.....	1.75	4.5	2.2	2.2	1.5	9.40	1.80	5.40
10	.....	.....	.....	.....	1.30	3.1	42.5	1.5	71.2	11.30	1.50	5.40
11	1.30	.....	.....	.....	1.30	9.1	2.2	2.8	15.4	2.20	1.10	4.40
12	.....	.....	126.74	12.00	1.30	42.5	1.5	2.8	2.2	1.50	5.40	4.40
13	.....	.....	209.90	.....	1.30	9.1	.9	2.3	1.5	1.50	7.20	4.40
14	.....	.....	94.50	.....	1.30	4.3	.8	2.0	1.2	2.20	2.60	4.40
15	.....	1.30	9.98	.....	1.30	8.4	.8	1.9	1.1	1.50	.....	4.40
16	.....	.....	128.30	.....	1.11	4.5	32.8	2.0	.9	1.10	.....	19.50
17	.....	.....	63.30	.....	1.11	2.2	20.6	2.2	.8	29.10	1.80	7.80
18	1.30	.....	19.50	.....	1.11	2.1	2.0	2.0	.8	.90	2.90	7.80
19	.....	.....	9.51	1.30	1.30	2.7	1.5	5.1	.7	120.80	3.90	10.50
20	.....	.....	.....	.....	1.30	1.5	42.5	3.1	.4	9.10	2.60	10.50
21	.....	.....	.....	1.30	1.30	7.8	149.5	3.2	1.1	3.90	2.20	10.50
22	4.69	1.30	2.48	.....	1.11	2.4	42.5	2.2	1.1	2.90	2.20	12.00
23	5.00	.....	.....	.....	(a)	1.7	5.4	.9	.8	6.90	5.40	7.80
24	.....	.....	.....	1.30	.....	2.7	2.2	.8	.8	4.90	4.90	6.60
25	1.30	.....	.....	1.30	.....	1.4	2.0	.7	.7	1.90	3.90	5.40
26	.....	.....	.....	2.48	.....	42.5	1.5	.7	3.8	1.10	4.90	5.40
27	.....	.....	.....	30.50	.....	2.0	20.6	.7	1.5	5.40	4.30	5.40
28	.....	4.69	.....	3.40	.....	1.5	9.0	.5	1.1	38.20	7.00	5.40
29	.....	.....	61.11	1.30	.....	2.4	5.1	.5	7.7	6.00	4.90	4.99
30	.....	.....	12.00	42.40	.....	42.5	2.2	.4	9.0	6.00	3.90	4.90
31	.....	.....	8.00	.....	.....	.....	1.0	.4	.....	6.00	.....	4.90
Mean	2.48	2.07	78.9	10.85	3.88	13.1	29.8	2.6	5.0	11.78	3.21	6.27

[a] Waste gate opened. Setting weir.

Precipitation, in inches, at Deerfield reservoir, New York.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	0.03					0.57			0.58			
2					0.04							
3				0.45				0.05	.53	0.45		
4		0.42		.34		.27	0.73			.15		
5	.10		0.71				1.43					
6				.04			.09	.55				
7	.19			1.04		1.16	.80					
8			1.50			1.07		.10			0.22	
9	.50			.17		.17		.60			.05	1.10
10		.23	.25		.19					.30		
11	.95				.95			.07	.79	.03		
12	.12		.07		.62						.96	
13			.12		.22				.42		1.10	
14			.21						.32	.72		
15	.23		.15					.73	.60		.05	
16		.59							.61		.02	
17		.19					.40		.34	.20		
18			.12		.93					.50		
19			.02	.17		.28						2.19
20												
21		.50	.77	.14		1.14						
22	.18					1.07						
23			.07	.56	.57							
24								.40			.03	
25				.50								
26							.10					
27					.22							.89
28												
29					.45		.24		.30		.03	.73
30				.17	.10			.18	.19			
31	.12				.18		.03					
Total	3.12	1.79	3.09	3.58	4.57	5.73	3.87	2.68	4.50	2.35	2.46	4.89

Precipitation, in inches, at Deerfield reservoir, New York—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1			1.15	0.12	0.03					0.44		
2		0.05	1.12	.18				0.41	0.20	.25		
3		1.25	.03	.03	.44		1.75					
4						0.35			.62	.02		0.50
5			1.12		.20	.72	1.43			.03		
6							.35	1.42		.35	0.10	
7		.03			.29		.03		.65			.15
8						.75	.11	.56		.40		
9		.25	.03	.60								
10		.03				.68	.42	.05	1.05			
11	0.03	.02	.65					.71				
12	.05			.10		.32					.23	.80
13	.03	.03	.75			.31	.22		.17			
14							.30			.20		
15						.54	.31				.20	
16			.85			.14		.10				1.30
17	.05							.10				.15
18		.25									.08	.05
19	.05				.65	.32	.60	.46		1.23	.15	
20							.80			.16		
21	.25			.07		.52		.48	.24			.40
22						.09	1.60	.28				.75
23					.02	.02				.16	.45	
24					.50	.32	.15		.03	.07		.05
25		.03			.30					.05	.02	
26	.02			.21	.43	.76			.75		.36	.08
27	.55			.05		.09	.62	.10		.51	.45	.11
28		1.00	.30		.35	.34	.43			1.70	.05	
29			.12			.68			1.40	.11		
30	.03		.10	.77	.72				.70		.02	
31			.02				.03			.25		
Total	1.06	2.94	6.24	2.13	3.93	6.95	9.15	4.67	5.81	5.93	2.11	4.34

WEST CANADA CREEK AT TWIN ROCK BRIDGE, NEW YORK.

The gaging station at this point was established September 7, 1900. The readings are furnished by the Utica Gas and Electric Company, and are taken twice each day by George Rood. The station is described in Water-Supply Paper No. 65, pages 153 to 155. The record at Twin Rock Bridge replaces one formerly kept at Middleville on the same stream. The record at Middleville from 1898 to 1901 is given in Water-Supply Paper No. 65, pages 155 to 157.

Current-meter discharge measurements of West Canada Creek at Twin Rock Bridge.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Sec.-feet.*
August 25	C. C. Covert	1.25	455
June 17	H. R. Beebe	2.34	1,142
Do	do	2.39	1,187
October 10	R. E. Horton	2.74	1,534
June 16	do	2.93	1,615
June 28	do	3.02	1,812
Do	H. R. Beebe	3.45	2,131
June 27	do	4.12	3,114
Do	do	4.52	3,402

Mean daily gage height, in feet, of West Canada Creek at Twin Rock Bridge.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2.00	1.90	4.90	4.75	5.20	2.15	3.10	1.55	1.00	2.30	3.10	1.60
2	2.00	1.90	6.80	3.90	3.95	2.10	3.35	1.50	.99	1.25	2.25	1.58
3	2.00	2.00	7.65	3.15	3.05	1.90	4.90	1.50	.78	1.35	2.35	2.65
4	2.00	2.00	6.40	2.40	3.15	3.25	7.05	1.43	.70	1.20	1.45	4.55
5	2.00	2.00	5.40	2.43	3.50	2.65	4.45	1.28	.90	1.25	1.50	3.90
6	2.00	2.00	4.25	2.30	2.65	1.95	3.60	1.80	1.10	1.23	1.85	3.85
7	2.00	2.00	3.75	2.35	2.75	2.45	2.55	2.50	1.10	1.23	2.25	4.55
8	2.00	2.00	3.30	2.38	2.30	2.10	2.55	2.33	1.45	3.00	2.05	1.95
9	2.00	2.00	3.40	5.45	2.10	1.70	2.42	2.70	1.80	3.30	1.90	1.70
10	2.00	2.00	3.10	5.25	2.10	2.10	2.35	2.65	1.70	2.70	1.65	1.73
11	2.00	2.00	3.08	3.65	1.85	3.13	2.10	2.40	1.55	1.63	1.50	2.45
12	2.00	2.00	3.50	3.43	1.70	2.80	1.53	3.15	1.05	1.40	1.65	2.45
13	2.00	2.00	5.10	3.45	1.45	2.45	1.30	2.40	1.00	1.30	3.00	2.20
14	2.00	2.00	6.85	3.65	1.28	2.25	1.23	1.95	1.15	1.28	3.20	2.05
15	2.00	2.00	5.05	2.75	1.00	2.95	1.80	1.70	1.03	1.20	2.20	2.10
16	2.00	1.90	5.70	2.50	1.00	2.90	4.00	1.45	.90	1.23	2.10	2.65
17	2.00	1.90	8.25	2.60	1.15	2.50	2.40	1.40	.90	1.00	2.35	6.00
18	2.00	1.85	7.00	2.45	1.33	1.90	2.18	1.30	.75	.75	2.13	5.65
19	2.00	1.68	7.25	2.35	1.33	1.63	1.90	1.55	.60	2.25	1.75	3.50
20	2.00	1.60	6.88	2.50	1.45	1.75	2.80	1.48	.50	3.70	1.63	2.80
21	2.00	1.53	3.50	2.25	1.43	1.80	4.13	1.60	.65	4.25	1.70	2.40
22	1.90	1.50	3.20	3.20	1.38	3.65	5.10	1.70	.60	3.80	1.85	6.10
23	1.80	1.90	3.80	2.75	1.30	2.95	4.28	1.68	.60	3.25	2.10	6.35
24	1.80	1.60	3.70	2.50	2.70	2.40	2.95	1.48	.60	3.23	1.45	5.20
25	1.90	1.53	3.43	2.55	3.50	1.90	2.50	1.30	.63	2.20	1.63	4.15
26	1.90	1.63	3.23	2.35	3.23	3.40	1.70	1.13	.73	2.50	1.50	3.53
27	1.90	1.38	3.05	3.10	2.85	4.30	1.43	1.00	1.00	3.00	1.63	3.35
28	1.90	1.85	3.40	3.30	2.60	3.15	1.75	.85	1.20	5.20	2.20	3.20
29	1.90	.....	6.30	2.43	2.50	2.55	1.95	.80	2.50	6.50	2.10	4.00
30	1.90	.....	8.00	4.15	2.80	3.70	1.65	.73	3.45	4.30	1.75	4.00
31	1.90	.....	6.00	.....	3.10	.....	1.45	1.10	.....	4.65	.....	3.90

EAST CANADA CREEK AT DOLGEVILLE, N. Y.

This gaging station was established September 23, 1898. A description of the drainage basin and recorded run-off for preceding years may be found in Water-Supply Paper No. 65, pages 158 to 161. The depth on the crest of the dam and readings of the gate opening of turbines are taken twice daily by John M. Kelley.

November 4 to 14 inclusive, 1901, a series of readings at one-half hour intervals from 6 a. m. to 6 p. m. was taken for the purpose of checking the discharge as calculated from the readings taken in the usual manner twice daily.

Discharge measurements of East Canada Creek.

Date.	Mean flow estimated from one-half hour observations.	Maximum daily flow.	Minimum daily flow.
1901.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
November 4	[a] 83.5	87.5	78
November 5	134.2	192.0	94
November 6	173.4	191.0	149
November 7	164.3	191.0	98
November 8	185.4	192.0	169
November 9	200.8	235.0	145
November 11	136.1	236.0	69
November 12	393.4	835.0	153
November 13	1,222.0	1,288.0	1,185
November 14	844.2	918.0	809

[a] Pond refilling, November 4, during several hours, reducing average outflow for day.

Mean daily flow, in second-feet, of East Canada Creek at Dolgeville, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	241	236	2,541	1,721	1,333	a 373	916	339	.....	639	1,033	497
2	241	a 190	a 2,620	1,322	881	216	796	334	74	558	a 827	473
3	254	236	2,370	1,102	883	187	1,364	a 139	195	502	673	460
4	239	231	1,954	774	a 756	86	2,037	209	103	436	592	892
5	a 180	236	1,429	572	693	1,032	1,562	264	115	a 396	575	748
6	211	236	1,200	a 532	549	579	a 1,143	330	117	499	593	849
7	166	236	791	583	522	437	869	436	a 106	578	601	a 665
8	166	236	638	581	418	a 376	635	246	187	711	578	880
9	171	a 175	a 482	682	362	381	435	337	151	619	a 570	638
10	159	211	483	2,363	296	341	813	a 264	355	477	476	646
11	159	196	467	1,689	a 264	621	538	319	297	401	434	1,228
12	a 100	181	1,101	1,329	281	524	402	241	154	a 29	508	956
13	121	156	1,633	a 1,281	192	458	a 232	160	132	412	687	629
14	129	81	1,798	1,109	192	669	205	127	a 100	545	688	a 607
15	136	81	1,645	736	171	a 738	245	121	135	497	684	1,332
16	136	a 40	a 1,886	620	139	581	394	107	293	420	a 665	1,320
17	136	81	4,307	622	133	420	302	a 64	251	417	561	2,033
18	133	81	2,796	620	a 110	349	231	166	201	411	549	1,954
19	a 95	81	1,574	539	221	298	196	160	201	a 1,971	596	1,333
20	136	81	1,200	a 539	327	365	a 994	219	221	1,732	561	1,092
21	159	81	1,046	539	249	857	1,349	209	a 10	1,283	505	a 1,148
22	216	81	1,167	542	192	a 956	2,131	193	101	856	549	2,516
23	451	a 40	a 1,236	434	135	619	1,381	160	165	750	a 492	1,921
24	526	81	1,429	422	460	363	769	(a)	218	681	422	1,495
25	781	81	1,489	331	a 954	297	1,029	67	172	760	381	1,675
26	a 530	81	1,200	332	708	1,219	709	67	662	a 628	436	864
27	486	511	1,079	a 290	499	1,143	a 617	67	507	648	532	822
28	481	736	1,046	342	340	827	1,029	64	a 418	865	626	a 708
29	456	.....	2,631	344	327	a 739	714	64	973	3,572	563	770
30	331	.....	a 3,855	1,510	410	801	508	163	853	2,834	a 609	720
31	231	.....	3,276	.....	435	.....	383	(a)	.....	1,656	.....	638
Mean	257	178	1,689	813	101	565	804	194	246	864	585	1,049

a Sunday.

Estimated monthly discharge of East Canada Creek at Dolgeville, N. Y.

[Drainage area, 256 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Sec.-ft.*		
January	257	1.00	1.15
February	178	.69	.72
March	1,689	6.59	7.35
April	813	3.17	3.65
May	101	.39	.45
June	565	2.59	2.99
July	804	3.14	3.50
August	194	.76	.84
September	246	.96	1.07
October	864	3.36	3.87
November	585	2.28	2.54
December	1,049	4.10	4.71
The year	612	2.42	32.84

EAST CANADA CREEK NEAR EASTCREEK, N. Y.

A series of current-meter measurements from boat and cable were made at a point about 2 miles above Eastcreek, N. Y., October 20 to November 6, 1900. The discharge measurements were made by Joseph Kemper, civil engineer, for the city of Little Falls. A current-meter measurement of the discharge was made each day during the continuation of the gage readings. The accompanying table shows the results of current-meter measurements and the corresponding daily gage readings. The velocity was measured at intervals of 5 feet across the stream by the six-tenths depth method. Meter No. 89 of the United States Geological Survey was used. The object of the measurements was to determine the effect of diversion from Spruce Creek and Beaver Brook, two tributaries of East Canada Creek entering above Dolgeville, and serving as sources of public water supply for Little Falls. Contemporaneous measurements of Spruce Creek, the results of which are given elsewhere, were also made. During the continuation of the measurements no water was drawn from Spruce Creek; the entire supply was taken from Beaver Brook, and there was no inflow from East Canada Creek to Beaver Brook, with the exception of the period from October 30 to November 2, inclusive. During this period the total flow of Beaver Brook, together with that

from Spruce Creek, entered East Canada Creek. The drainage area above the point of measurement is 280 square miles.

Measured discharge of East Canada Creek near Eastcreek, N. Y.

Date.	Gage height.	Discharge.	Run-off.
1901.	*Feet.*	*Second-feet.*	*Second-feet per square mile*
October 20	1.41	301.33	1.07
October 21	1.40	289.92	1.04
October 22	1.28	238.66	.85
October 23	1.29	228.55	.82
October 24	1.40	313.43	1.12
October 25	1.20	220.76	.79
October 26	1.19	201.47	.72
October 27	1.17	175.69	.63
October 28	1.04	182.64	.65
October 29	1.15	176.24	.63
October 30	1.17	[a]214.78	.77
October 31	1.25	[a]228.76	.82
November 1	1.19	[a]221.50	.79
November 2	1.22	[a]218.60	.78
November 3	1.11	177.48	.63
November 4	1.12	172.84	.62
November 5	1.14	173.76	.62
November 6	1.18	188.56	.67

[a] Including Beaver Brook.

MOHAWK RIVER AT LITTLE FALLS, N. Y.

This gaging station was established September 23, 1898, and is described in Water-Supply Paper No. 65, pages 162 to 165, where the monthly mean run-off for preceding years may be found. The gaging station is situated at the dam and mills of the Gilbert Knitting Company and the Little Falls Paper Company, where records of the depth wasted over the dam and of the run of the water wheels are kept.

The spring freshet of March 1 and 2, 1902, caused a discharge in Mohawk River at Little Falls estimated at 27,000 second-feet, or 20.7 second-feet per square mile.

Mean daily flow, in second-feet, of Mohawk River at Little Falls, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	1,332	1,519	13,024	6,791	6,306	[a]3,163	4,725	1,777	1,084	2,587	4,122	2,399
2	1,373	[a]1,107	[a]27,505	5,334	4,506	2,297	4,889	3,863	1,069	1,806	[a]2,829	1,178
3	1,410	1,163	22,173	5,099	3,752	2,141	5,821	[a]2,641	1,110	1,437	2,414	2,693
4	1,296	889	15,793	4,268	[a]3,650	2,176	1,232	1,875	1,110	1,447	2,297	3,436
5	[a]1,103	1,039	10,117	3,610	3,201	4,646	9,320	1,631	1,026	[a]1,563	2,141	5,952
6	1,368	1,119	7,680	[a]3,287	3,139	3,141	[a]8,486	2,077	956	1,760	2,028	2,239
7	1,369	1,119	5,951	3,310	3,528	2,162	6,800	5,001	[a]1,454	2,255	1,737	[a]1,957
8	1,369	924	4,989	3,003	2,584	[a]2,283	6,040	4,931	1,568	3,205	2,599	1,839
9	1,326	[a]939	[a]4,087	3,318	1,938	3,305	5,262	4,920	1,649	2,997	[a]1,856	1,646
10	1,286	956	3,850	7,759	1,710	2,456	5,088	[a]3,403	2,761	2,247	1,957	1,536
11	1,256	956	3,847	7,135	[a]1,660	4,351	4,272	2,478	2,466	2,113	1,737	1,762
12	[a]963	1,039	8,669	5,145	1,223	4,263	3,548	3,644	1,601	[a]1,623	2,245	1,813
13	1,115	1,039	14,508	[a]3,870	1,340	4,057	[a]2,082	3,179	1,348	1,613	3,310	1,616
14	1,115	1,039	14,866	4,002	1,383	3,273	1,878	2,230	[a]1,141	1,613	3,577	[a]1,635
15	1,155	1,018	11,881	3,256	1,210	[a]3,152	2,012	1,779	1,435	1,567	2,715	1,877
16	1,160	[a]770	[a]14,465	3,003	1,167	4,473	5,718	1,510	1,250	1,472	[a]2,261	2,004
17	1,120	956	13,886	2,287	1,215	3,426	4,498	[a]1,642	1,290	1,305	1,998	5,565
18	1,093	699	15,440	2,692	[a]857	3,119	2,878	1,065	922	1,191	2,519	5,797
19	[a]936	9[illegible]6	9,744	1,437	1,603	1,783	2,602	1,778	951	4,628	2,028	5,958
20	1,551	956	7,177	[a]1,988	1,603	1,830	[a]4,740	1,870	954	[a]5,631	1,939	5,177
21	952	921	5,176	2,404	1,559	1,649	7,299	1,616	[a]828	4,070	1,838	[a]4,817
22	1,155	893	4,684	2,015	1,112	[a]3,782	8,699	1,616	798	2,526	1,852	6,605
23	2,458	[a]2,404	[a]5,150	2,128	1,111	2,959	7,306	1,844	943	2,517	[a]2,214	7,890
24	2,341	1,039	5,572	2,336	1,691	2,287	6,114	[a]1,664	812	2,933	2,589	6,082
25	2,237	1,039	5,255	2,014	[a]4,322	1,831	4,261	1,480	481	2,316	2,354	5,301
26	[a]1,436	1,211	4,632	1,933	4,494	3,291	3,158	1,328	871	2,951	1,892	4,576
27	1,729	1,689	4,352	[a]2,733	5,020	6,027	[a]4,073	1,197	996	[a]2,558	3,315	3,275
28	2,133	3,449	4,195	2,773	4,132	4,977	4,701	1,284	[a]924	10,758	4,650	[a]2,825
29	1,971	.....	5,849	2,355	3,309	[a]3,326	3,429	1,018	3,249	11,311	3,748	2,574
30	1,786	.....	[a]9,329	4,093	3,718	3,503	2,462	986	3,511	8,373	[a]2,476	2,235
31	1,637	.....	9,336	.....	4,812	.....	2,086	([a])	.....	7,225	.....	2,464
Mean	1,433.2	1,173.1	9,457.5	3,512.6	2,640.5	3,170.9	4,984.2	2,244.9	1,351.9	3,283.8	2,508	3,448

[a] Sunday.

Estimated monthly discharge of Mohawk River at Little Falls, N. Y.

[Drainage area, 1,306 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Sec. feet.*		
January	1,433	1.10	1.2
February	1,173	.90	.9
March	9,457	7.25	8.3
April	3,513	2.69	3.0
May	2,641	2.02	2.3
June	3,171	2.43	2.7
July	4,984	3.82	4.4
August	2,200	1.68	1.9
September	1,352	1.03	1.1
October	3,284	2.51	2.8
November	2,508	1.94	2.2
December	3,448	2.64	2.9
The year	3,264	2.50	34.1

SCHOHARIE CREEK AT MILLPOINT, N. Y.

The record at this station, which is maintained to replace temporarily the record at Schoharie Falls dam on the same stream, has been continued throughout the present year. No discharge measurements were made during 1902. A description of this station and the results of records kept on Schoharie Creek at Fort Hunter and Schoharie Falls may be found in Water-Supply Paper No. 65, pages 167 to 172.

Daily gage height, in feet, of Schoharie Creek at Millpoint, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2.90	1.45	9.85	4.00	2.55	1.25	2.00	2.30	0.85	4.15	2.45	1.55
2	2.50	1.45	7.60	3.70	2.35	1.15	2.00	3.20	.90	3.50	2.20	1.50
3	1.85	1.45	6.70	3.50	2.15	1.10	1.95	2.90	.75	2.75	2.15	1.45
4	1.70	1.45	4.80	2.90	1.90	1.50	1.95	2.45	.70	2.70	2.10	1.60
5	1.60	1.40	4.20	2.50	2.00	1.45	2.00	2.95	.65	2.70	2.00	1.65
6	1.60	1.40	3.60	2.10	1.85	1.35	2.05	1.70	.65	2.35	1.90	1.75
7	1.55	1.35	2.85	2.05	1.70	1.25	2.05	1.60	.60	2.20	1.89	1.80
8	1.50	1.35	2.25	2.05	1.65	1.25	2.10	1.40	.60	2.05	1.75	1.90
9	1.50	1.35	2.15	2.25	1.60	1.20	2.00	1.20	.60	1.95	1.60	2.30
10	1.50	1.40	3.10	6.00	1.50	1.20	1.85	1.40	.55	1.70	1.55	3.00
11	1.45	1.50	3.70	[illegible]	1.45	1.15	1.65	1.50	1.60	1.65	1.55	3.10
12	1.45	1.55	5.05	[illegible]	1.40	1.30	1.55	1.50	1.55	1.89	1.50	3.05
13	1.45	1.50	6.17	[illegible]	1.40	1.25	1.40	1.45	1.55	2.50	1.50	2.95
14	1.45	1.50	5.20	[illegible]	1.35	1.25	1.25	1.35	1.50	2.25	1.45	2.90
15	1.40	1.50	4.[illegible]	3.00	1.35	1.20	1.15	1.25	1.45	2.10	1.40	2.90
16	1.35	1.35	6.35	3.00	1.30	1.20	1.10	1.15	1.35	1.90	1.40	2.95
17	1.35	1.45	4.30	2.80	1.25	1.20	1.05	1.10	1.30	1.75	1.35	4.90
18	1.30	1.40	3.75	2.50	1.20	1.15	1.00	1.05	1.30	1.70	1.30	3.60
19	1.30	1.40	3.35	[illegible]	1.20	1.15	.95	1.00	1.35	1.70	1.30	3.50
20	1.30	1.40	3.40	[illegible]	1.15	1.10	1.07	1.05	1.60	1.65	1.30	3.45
21	1.35	1.35	2.30	[illegible]	1.10	1.20	6.47	1.50	1.60	1.60	1.30	3.40
22	1.50	1.50	2.10	1.65	1.05	1.20	5.10	1.30	1.35	1.55	1.25	6.65
23	4.30	1.50	2.35	1.35	1.00	1.25	4.50	1.15	1.20	1.50	1.25	6.00
24	3.15	1.50	2.35	1.30	.95	1.25	4.20	1.05	1.15	1.45	1.25	3.10
25	2.30	1.50	2.30	1.30	.95	1.20	4.10	1.00	1.10	1.40	1.25	2.75
26	2.15	1.55	3.15	1.85	.95	1.20	3.10	.90	1.20	1.35	1.20	2.50
27	2.20	1.55	3.25	1.80	1.00	1.15	2.80	.85	1.80	1.30	1.20	2.40
28	2.00	1.60	3.50	1.80	1.10	1.10	2.60	.85	4.02	4.12	1.70	2.35
29	1.85	.....	3.80	1.75	1.20	1.10	2.50	.90	5.85	4.26	1.65	2.15
30	1.75	.....	4.00	2.10	1.35	1.10	2.30	.90	4.80	2.90	1.55	2.10
31	1.60	.....	4.10	.....	1.30	.....	2.30	.85	.....	2.70	.....	2.15

SCHOHARIE CREEK AT PRATTSVILLE, GREENE COUNTY, N. Y.

Schoharie Creek above Prattsville drains a rugged mountainous area almost entirely wooded. The drainage basin, embracing an area 243 square miles, lies wholly within Greene County. The basin is surrounded by continuous mountain ranges, and intervening ridges divide the main stream from its principal tributaries, Batavia Kill, East Kill, and West Kill.

A gaging station was established at the highway bridge in Prattsville village November 7, 1902, by C. C. Covert; the gage datum is referred to the United States Geological Survey bench mark, a circle marked on a bowlder on right-hand end of bridge on the downstream side; elevation 1,151 feet. A 15-foot weight and wire gage, having a boxed horizontal scale, is attached to the steel floor beams of the bridge on the upstream side. The elevation of the water surface

when the gage reads zero is 1,130.03. The bridge has a single span o 185 feet. Measurements are made on the downstream side. Bridg is divided into 10-foot intervals, beginning at top of left-han abutment.

The river stage is observed at 7 to 8 a. m. and 4 to 5 p. m. each da by James Brennam. A current-meter measurement by C. C. Cover November 7, 1902, showed a flow of 342 second-feet, the gage heigh being 5.565. A measurement by F. H. Tillinghast December 4, 1902 gage height 5.60, showed a discharge of 345 second-feet.

Mean daily gage height, in feet, of Schoharie Creek at Prattsville, N. Y.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec
1902.			1902.			1902.		
1		5.20	12	5.40	5.30	23	5.10	7.3
2		5.20	13	5.35	5.20	24	5.10	6.4
3		5.50	14	5.30	5.20	25	5.35	6.1
4		5.60	15	5.30	5.20	26	5.15	6.0
5		5.53	16	5.30	5.20	27	5.40	5.9
6		5.50	17	5.30	7.55	28	5.55	5.8
7		5.50	18	5.30	7.20	29	5.30	5.8
8		5.50	19	5.20	6.18	30	5.30	5.7
9	5.40	5.45	20	5.20	6.00	31		5.7
10	5.40	5.40	21	5.20	5.95			
11	5.40	5.25	22	5.20	9.30			

MOHAWK RIVER AT DUNSBACH FERRY, N. Y.

This station is located at the dam of the West Troy Water Com pany, 9 miles from the mouth of Mohawk River. The station wa established March 12, 1898, and a record has been maintained sinc that date with the exception of the period April, 1899, to August, 190

Records were formerly maintained on Mohawk River at the Ne York State dam at Rexford Flats and at Freeman's bridge, Schene tady, about 4 and 8 miles above Dunsbach Ferry, respectively. Owin to the practical duplication of these records at Dunsbach Ferry gagin station, the Rexford Flats and Freeman's bridge stations were discon tinued January 1, 1902. Description of the gaging station at Duns bach Ferry, as well as the others mentioned, may be found in Wate Supply Paper No. 65, pages 172 to 183, where the results of gaging are also given.

The left wing of the Dunsbach Ferry dam was injured during hig water of 1902, necessitating a slight change in the discharge calcula tion. Owing to roughness of the injured portion of the crest, th data are considered somewhat less precise than formerly. Repai are in progress. During the year 1902 a 66-inch old pattern America turbine in the adjoining pumping station has been replaced by a 5 inch Victor turbine. A record of the effective head of the water wheel

and of the extent to which the wheels are run is kept, from which the discharge through the turbines is calculated and added to the flow over the dam to obtain the total flow of the stream.

Mean daily flow, in second-feet, of Mohawk River at Dunsbach Ferry, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	5,120	3,320	(a)	15,700	5,840	2,950	5,450	3,825	1,250	12,050	9,950	6,300
2	3,151	3,151	(a)	12,325	9,100	2,650	6,500	4,125	1,250	8,400	6,975	5,870
3	3,151	2,644	.....	9,600	8,475	2,350	7,850	3,825	1,200	6,500	5,675	5,870
4	3,320	2,644	45,550	8,375	6,750	3,500	8,375	4,125	1,250	4,850	4,700	7,670
5	2,982	2,544	25,150	6,500	6,925	3,500	9,100	3,225	1,200	4,300	4,525	12,100
6	2,813	2,206	17,550	5,650	6,925	2,925	9,100	2,500	1,200	3,675	4,025	10,200
7	2,644	2,106	12,350	5,200	4,850	2,925	12,750	3,825	1,200	3,300	3,875	7,200
8	2,475	2,106	7,150	4,470	4,470	2,350	9,900	5,840	1,225	3,400	3,725	5,100
9	2,644	2,037	6,250	8,100	3,950	3,050	7,150	5,225	1,275	3,250	3,725	3,880
10	2,644	1,768	6,250	16,425	3,350	2,925	5,225	4,470	1,545	3,725	3,575	3,100
11	2,306	1,599	6,700	23,200	3,050	3,225	4,470	3,975	2,350	3,550	3,070	3,730
12	2,475	1,868	9,900	20,300	2,925	4,300	3,975	4,125	2,950	3,550	3,070	4,120
13	2,475	1,699	34,000	13,800	2,650	5,450	3,500	3,025	2,950	4,025	4,025	4,300
14	2,137	1,530	34,000	9,625	2,100	4,650	2,925	2,800	2,650	3,900	5,475	4,530
15	1,968	1,429	23,450	7,625	2,100	5,025	3,050	1,825	2,500	3,550	6,300	4,900
16	1,799	1,630	20,700	5,225	1,950	6,050	2,925	1,545	2,250	3,400	5,100	5,280
17	1,799	1,429	28,450	5,040	1,675	6,500	2,650	1,475	1,950	3,250	4,175	9,150
18	1,429	1,429	32,350	4,470	1,545	4,850	2,925	1,350	1,545	2,850	4,025	19,700
19	1,630	1,429	23,260	3,825	1,475	4,125	2,925	1,400	1,400	4,520	4,025	16,710
20	1,429	1,429	14,105	3,200	1,400	3,200	6,500	1,450	1,325	8,930	4,175	14,530
21	1,630	1,429	10,400	3,200	1,545	1,725	15,700	1,475	1,250	1,495	3,725	12,950
22	2,136	1,429	9,350	2,780	2,350	2,225	21,775	1,950	1,200	9,950	3,725	16,450
23	6,022	(a)	11,050	2,650	1,675	1,825	19,200	1,825	1,200	5,275	3,400	29,350
24	7,923	.....	12,650	2,780	1,825	1,825	14,700	1,675	1,200	4,900	3,250	22,950
25	6,022	.....	11,500	3,675	2,800	3,050	14,125	1,475	1,200	5,700	3,100	11,200
26	3,720	.....	10,150	3,050	3,825	2,800	9,100	1,400	1,200	5,275	4,010	7,150
27	4,520	.....	9,100	3,050	5,450	3,350	7,850	1,350	1,350	6,000	4,900	7,150
28	4,520	.....	7,850	3,050	7,150	4,850	6,925	1,350	2,650	15,750	7,200	5,100
29	4,720	.....	9,650	3,825	5,250	4,350	6,500	1,300	8,475	28,150	8,650	3,750
30	4,320	.....	17,100	4,125	4,300	4,125	4,850	1,300	17,400	18,200	7,000	4,730
31	3,920	.....	19,650	.....	3,400	.....	3,825	1,300	.....	14,775	.....	5,100

(a) No record from February 23 to March 3.

Estimated monthly discharge of Mohawk River at West Troy Company's Dam, at Dunsbach Ferry, N. Y.

[Drainage area, 3,440 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Sec.-feet.*		
January	3,253	.95	1.09
February 1 to 22	[a] 1,948	[a] .57	[a] .59
March 4 to 31	[a] 16,986	[a] 4.94	[a] 5.68
April	7,361	2.14	2.39
May	3,906	1.14	1.31
June	3,554	1.03	1.15
July	4,251	1.24	1.43
August	2,592	.75	.86
September	2,386	.69	.77
October	6,466	1.88	2.17
November	4,771	1.39	1.55
December	9,036	2.63	3.03
The year	5,542	1.61	22.02

[a] Partial month. Record for days of high flood not obtainable. Due to break in dam.

UPPER HUDSON DRAINAGE BASIN.

INDIAN RIVER AT INDIAN LAKE DAM, HAMILTON COUNTY, N. Y.

This record includes the stage of water in and amount of draught from Indian Lake storage reservoir. The reservoir was built for the purpose of ameliorating the water-power deficiency to mills on Hudson River during low water. The dam is of masonry and forms a lake having a surface area of 7.87 square miles or 5.54 per cent of the drainage area of 142 square miles.

Stage of water in Indian Lake reservoir at Indian Lake, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	20.08	18.79	15.00	29.92	36.17	35.54	36.25	34.88	31.92	28.92	29.08	25.58
2	20.17	18.75	15.42	30.33	36.17	35.54	36.29	34.79	31.75	28.75	28.83	25.67
3	20.21	18.71	16.17	30.58	36.17	35.58	36.33	34.75	31.58	28.58	28.58	25.79
4	20.21	18.67	16.67	30.83	36.13	35.58	36.46	34.67	31.38	28.42	28.33	25.92
5	20.25	18.63	17.08	31.08	36.08	35.58	36.42	34.58	31.17	28.33	28.08	26.00
6	20.29	18.58	17.42	31.25	36.00	35.58	36.29	34.67	31.00	28.50	27.92	26.00
7	20.33	18.54	17.75	31,42	35.79	35.63	36.13	34.75	30.83	28.17	27.75	25.83
8	20.33	18.50	18.00	31.58	35.63	35.67	36.00	34.83	30.71	28.17	27.67	25.67
9	20.37	18.46	18.17	32.08	35.50	35.67	35.88	34.83	30.75	28.21	27.75	25.50
10	20.42	18.42	18.33	33.00	35.42	35.67	35.79	34.75	30.88	28.25	27.83	25.33
11	20.42	18.37	18.50	33.50	35.33	35.67	35.63	34.75	30.79	28.33	27.92	25.17
12	20.33	18.33	18.83	33.75	35.17	35.67	35.50	34.67	30.54	28.37	28.00	25.08
13	20.25	18.29	19.17	34.00	35.00	35.67	35.42	34.58	30.29	28.42	28.17	25.00
14	20.12	18.25	19.75	34.25	34.92	35.71	35.42	34.54	30.33	28.50	28.37	25.08
15	20.08	18.17	20.25	34.42	34.83	35.75	35.50	34.46	30.33	28.50	28.21	25.17
16	19.00	17.92	20.67	34.58	34.75	35.75	35.67	34.38	30.33	28.46	28.04	25.33
17	19.92	17.58	21.83	34.71	34.63	35.75	35.63	34.33	30.38	28.42	27.83	25.50
18	19.79	17.21	22.92	34.83	34.50	35.75	35.54	34.25	30.42	28.42	27.67	25.67
19	19.67	16.92	23.58	35.00	34.42	35.79	35.50	34.17	30.46	28.42	27.50	25.83
20	19.58	16.67	24.00	35.00	34.38	35.79	35.58	34.00	30.50	28.42	27.33	25.83
21	19.50	16.42	24.33	34.96	34.33	35.83	35.75	33.83	30.54	28.42	27.17	25.83
22	19.50	16.25	24.58	34.92	34.25	35.83	35.92	33.71	30.54	28.46	27.00	25.92
23	19.50	16.00	24.83	34.92	34.33	35.83	35.92	33.58	30.42	28.50	26.83	26.00
24	19.42	15.75	25.17	34.96	34.54	35.88	35.75	33.42	30.17	28.58	26.67	26.00
25	19.33	15.50	25.42	35.00	34.67	35.92	35.58	33.21	29.88	28.75	26.50	26.00
26	19.25	15.25	25.67	35.25	34.92	35.96	35.42	33.00	29.67	28.92	26.33	25.92
27	19.17	15.00	26.00	35.42	35.08	36.08	35.38	32.83	29.50	29.08	26.17	25.75
28	19.08	14.83	26.50	35.50	35.25	36.17	35.25	32.67	29.33	29.30	26.00	25.63
29	19.00	.....	17.33	35.50	35.33	36.17	35.17	32.50	29.17	29.42	25.83	25.42
30	18.92	.....	28.50	36.00	35.38	36.17	35.08	32.25	29.04	29.42	25.67	25.29
31	18.83	.....	29.25	.....	35.50	.....	34.96	32.08	.....	29.37	.....	25.17

SCHROON RIVER NEAR WARRENSBURG, N. Y.

The record at this station, which is situated at the dam and mill of the Schroon River Pulp Company near the mouth of Schroon River, a tributary of Upper Hudson River, was established November, 1895. A record of the run-off for preceding years together with a description of the drainage area may be found in Water-Supply Paper No. 65, pages 45 to 47. The high water of March 21, 1902, resulted in a discharge of 7,042 second-feet at this dam or 12.51 second-feet per square mile from the tributary drainage area of 563 square miles. The record has been maintained in cooperation with the officials of the Schroon River Pulp Company. The record for the first three months of 1902 is given herewith. Owing to change in management of company, the data for the remaining months of the year are not available at present.

Mean daily flow, in second-feet, of Schroon River below Warrensburg, N. Y.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1902.				1902.				1902.			
1	761	612	740	12	(a)	535	4,462	23	612	(a)	(a)
2	761	(a)	(a)	13	574	535	4,652	24	612	477	3,732
3	761	574	2,957	14	574	535	5,087	25	612	477	3,352
4	761	574	3,052	15	574	535	5,397	26	(a)	477	3,152
5	(a)	574	3,287	16	574	(a)	(a)	27	612	535	2,902
6	761	574	3,392	17	574	574	5,497	28	612	535	2,792
7	761	574	3,482	18	574	477	5,647	29	612	.....	2,712
8	806	574	3,287	19	(a)	477	5,647	30	612	.....	(a)
9	806	(a)	(a)	20	612	477	5,497	31	612	.....	3,052
10	806	574	2,582	21	612	477	7,042				
11	768	535	2,377	22	612	477	4,342				

[a] Sunday.

Estimated monthly discharge of Schroon River below Warrensburg, N. Y.

[Drainage area, 563 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Sec.-feet.*		
January	664	1.18	1.36
February	532	0.95	0.99
March	3,850	6.85	7.88

HUDSON RIVER AT FORT EDWARD, N. Y.

This station was established by George W. Rafter in connection with the Upper Hudson storage surveys in 1895. The record preceding the year 1899 has not been published. The station is described and the results as to run-off are given in Water-Supply Paper No. 65, pages 48 to 50.

Mean daily flow, in second-feet, of Hudson River at Fort Edward, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2,751	1,366	2,491	14,307	7,600	[a] 4,865	5,192	5,288	2,231	4,763	8,894	3,888
2	2,166	[a] 2,237	[a] 8,140	12,870	10,259	6,738	5,192	5,197	2,715	5,031	[a] 10,460	3,475
3	2,478	2,963	17,818	9,155	4,817	4,626	14,597	[a] 7,255	2,449	2,624	9,317	3,491
4	1,128	2,193	20,450	8,479	[a] 7,255	4,626	15,310	8,254	2,276	2,085	7,335	4,357
5	[a] 2,231	2,193	19,985	4,498	9,661	5,192	15,244	6,081	2,105	[a] 2,530	6,315	4,420
6	2,647	2,219	15,099	[a] 4,135	7,176	5,192	[a] 10,460	5,134	1,104	4,053	5,611	1,898
7	2,247	2,593	15,241	5,213	8,829	2,776	10,149	7,286	[a] 3,155	4,219	5,396	[a] 2,834
8	2,647	1,248	13,110	4,902	6,351	[a] 4,135	7,926	7,286	3,823	4,312	2,804	3,619
9	2,942	[a] 2,231	[a] 13,670	4,642	6,022	6,684	6,081	5,256	3,200	4,312	[a] 4,865	3,483
10	2,674	2,447	8,169	10,335	2,776	4,626	5,821	[a] 7,255	2,924	4,053	5,035	3,211
11	1,144	2,447	7,821	15,170	[a] 4,135	4,626	5,821	8,272	3,481	1,546	3,900	3,634
12	[a] 2,231	2,193	8,000	11,997	4,829	5,195	2,916	5,992	3,220	[a] 1,950	3,740	3,718
13	2,767	2,193	7,976	[a] 12,030	4,568	1,578	[a] 4,135	6,042	1,896	3,225	4,025	1,558
14	2,507	2,193	15,178	10,487	4,569	4,135	4,594	5,461	[a] 2,814	2,835	4,310	[a] 3,474
15	2,247	1,155	15,754	7,625	4,254	[a] 6,235	2,949	5,036	3,504	3,135	2,804	2,329
16	2,647	[a] 1,950	[a] 15,310	7,086	4,281	6,685	4,743	2,906	2,452	3,628	[a] 6,035	2,827
17	2,507	2,162	29,707	6,240	1,958	4,886	5,192	[a] 4,135	2,107	4,053	7,287	4,401
18	1,144	2,334	25,031	5,554	[a] 115	5,031	4,886	3,968	1,723	1,899	5,396	6,632
19	[a] 1,950	2,221	21,577	2,822	3,894	5,192	2,389	3,876	1,983	[a] 4,135	5,031	5,590
20	2,108	2,478	18,306	[a] 4,135	5,821	6,683	[a] 5,645	3,791	897	6,684	5,192	3,217
21	1,966	2,479	12,977	6,931	4,025	5,198	7,556	3,791	[a] 1,680	5,611	5,396	[a] 5,654
22	1,765	1,273	10,483	5,135	3,483	[a] 6,235	7,235	3,791	1,699	5,396	3,277	8,263
23	2,369	[a] 1,950	[a] 13,130	4,028	3,482	8,742	9,368	1,718	1,547	4,886	[a] 4,135	10,037
24	3,145	2,479	10,421	4,028	1,728	5,399	9,712	[a] 2,231	1,459	4,363	4,364	10,037
25	1,740	2,339	10,539	3,769	[a] 30	4,886	9,266	4,676	1,579	4,159	4,364	7,680
26	[a] 3,155	2,447	8,431	1,992	4,421	4,686	6,147	3,506	2,047	[a] 4,135	4,310	9,550
27	3,785	2,858	9,155	[a] 5,645	4,420	5,192	[a] 6,835	3,248	872	4,421	4,310	6,126
28	3,360	3,262	7,823	6,576	4,421	2,850	7,658	2,963	[a] 3,474	4,369	4,310	[a] 6,835
29	2,969	.....	5,386	6,575	3,822	[a] 7,255	7,556	3,802	4,857	10,588	1,982	6,632
30	2,711	.....	[a] 11,500	5,439	4,440	8,639	6,931	1,294	4,712	14,074	[a] 5,654	5,590
31	2,969	.....	14,127	.....	2,005	.....	5,830	[a] 2,231	.....	15,014	.....	5,348

[a] Sundays.

Estimated monthly discharge of Hudson River at Hudson Paper Mill Company's mill at Fort Edward, N. Y.

[Drainage area, 2,800 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Sec.-feet.*		
January	2,422	0.86	0.99
February	2,218	.79	.82
March	13,316	4.75	5.47
April	7,060	2.52	2.81
May	4,692	1.67	1.93
June	5,293	1.53	1.71
July	7,204	2.57	2.96
August	4,743	1.69	1.95
September	2,466	.88	.98
October	4,841	1.73	1.98
November	5,191	1.87	2.09
December	4,961	1.76	2.03
The year	5,367	1.88	25.72

HUDSON RIVER AT MECHANICVILLE, N. Y.

This gaging record, which has been maintained since 1888 by the Duncan Company at their dam and paper mill, is furnished by R. P. Bloss, C. E., engineer of the company. The station is described in Water-Supply Paper No. 65, pages 50 to 53, and the run-off data for the years 1898 to 1901 are given. The run-off for earlier years may be found in the annual reports of the United States Geological Survey on Progress of Stream Measurements.

Mean daily flow, in second-feet, of Hudson River at Mechanicville, N. Y.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.											
1	5,019	37,064	28,287	18,099	6,444	6,524	6,812	2,621	6,823	a14,276	a6,180
2	5,050	27,300	24,412	18,886	7,611	6,524	8,193	4,245	6,233	a11,253	a4,928
3	5,697	41,362	20,724	15,881	6,174	6,976	7,986	a3,201	6,547	a12,350	a4,849
4	4,160	32,881	17,576	14,365	6,883	10 275	9,530	a2,972	5,504	a10,094	a4,995
5	3,754	29,491	14,989	16,173	6,635	14,487	8,555	a3,071	4,431	a8,822	a6,241
6	3,625	21,893	.....	14,315	6,810	12,225	6,933	a3,178	6,319	a8,044	a5,775
7	3,658	21,145	12,778	14,820	6,361	11,698	8,393	a1,789	5,029	a7,592	a3,331
8	3,358	19,256	10,843	11,988	5,050	9,523	9,168	a5,021	5,637	a7,362	a5,524
9	3,925	15,848	11,848	11,192	7,398	8,335	9,289	a4,216	5,795	a6,087	a5,007
10	4,313	16,575	22,112	10,843	5,985	8,148	8,174	a4,181	5,477	a7,328	a4,186
11	3,509	14,541	26,913	9,360	6,436	7,748	9,593	a4,441	5,020	a5,688	a5,411
12	3,889	17,686	25,250	8,923	6,086	6,607	8,955	a4,718	3,471	a5,279	a5,548
13	4,034	23,312	24,323	7,645	5,836	4,775	8 630	a4,718	6,033	a5,229	a5,105
14	3,964	26,187	21,012	7,848	5,437	6,111	7,628	a3,735	4,557	a5,442	a6,725
15	3,818	25,211	16,448	7,070	4,009	4,940	8,140	a5,613	4,502	a6,644	a6,896
16	3,944	.....	13,603	6,210	6,529	5,755	6,118	a3,944	4,812	a6,726	a5,507
17	5,353	33,274	13,060	6,463	7,173	6,242	4,569	a3,348	4,871	a8,536	a15,846
18	4,103	42,940	11,755	5,756	6,798	6,567	5,842	a3,025	4,855	a7,085	a13,714
19	4,778	37,036	10,743	4,102	6,798	5,407	4,837	a2,737	3,831	a6,720	a11,962
20	5,038	30,551	8,895	5,662	6,086	5,375	4,489	a2,712	7,669	a6,273	a10,219
21	5,126	26,048	11,539	6,012	5,812	14,311	4,477	1,707	7,574	a6,961	a8,858
22	5,308	24,000	10,071	6,632	5,250	13,391	4,677	4,114	7,174	a6,181	21,649
23	5,788	21,698	9,348	4,965	6,848	12,334	4,552	3,134	6,635	a4,504	21,787
24	6,212	22,387	9,959	4,620	6,886	11,231	3,350	2,940	5,971	a6,724	16,410
25	4,337	19,648	8,446	4,100	6,140	12,346	5,419	2,835	5,457	a5,639	12,697
26	4,488	18,311	8,336	7,748	5,600	11,376	4,270	2,597	3,907	a5,206	13,808
27	7,353	16,723	9,110	8,760	6,074	9,315	4,109	2,793	6,442	a5,239	12,514
28	9,160	16,035	13,298	13,899	6,988	11,501	3,722	2,818	10,658	a5,775	10,172
29	.....	19,815	12,098	9,398	5,876	10,049	3,586	6,125	a17,901	a5,410	10,939
30	.....	23,220	13,672	9,973	7,461	8,948	3,294	6,741	a17,631	a3,840	8,881
31	.....	29,487	.....	10,521	.....	7,936	1,539	.....	a16,951	.....	8,393

a Flashboards irregular; results approximate.

NOTE.—Record not available for January.

Estimated monthly discharge of Hudson River at Mechanicville, N. Y.

[Drainage area, 4,500 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1902.	*Sec.-feet.*		
February	4,741	1.52	1.58
March	25,130	5.53	6.36
April	15,222	2.38	3.77
May	7,949	1.76	2.03
June	6,315	1.40	1.56
July	8,934	1.98	2.28
August	6,286	1.40	1.61
September	3,643	.81	.90
October	6,894	1.53	1.76
November	7,076	1.41	1.58
December	9,162	1.83	2.11

QUACKENKILL CREEK AT QUACKENKILL VILLAGE, N. Y.

The headwaters of Quackenkill Creek lie in a series of storage ponds in central Rensselaer County. These ponds, four in number, have a combined water-surface area of 0.15 square mile. They are situated at an average elevation of 1,485 feet above tide. Quackenkill is tributary to Poestenkill, and the ponds are utilized by mills at Troy to equalize the extremes of flow and increase the low-water discharge of the latter stream. The drainage area of the Quackenkill is for the most part cleared and precipitous.

A gaging record was maintained on the Quackenkill, below the lower highway bridge in Quackenkill village, during 1894. A weir having a crest 8 feet in length was erected across the stream, and observations of the depth on the weir at a stake a short distance upstream were taken daily. The discharge was calculated by the Francis formula. The drainage area above the point of gaging is 18.5 square miles, and above the junction of the stream with the Poestenkill is 30.5 square miles.

The record has been furnished by William G. Raymond, consulting engineer of department of water supply of Troy.

Mean daily flow, in second-feet, of Quackenkill Creek at Quackenkill village, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1894.												
1	23.9	13.8	8.9	29.4	15.7	31.8	1.2	8.7	10.2	1.3	34.3	14.6
2	27.7	14.6	14.7	27.2	14.4	50.1	.9	8.7	8.6	1.3	36.0	11.7
3	31.6	13.3	23.9	17.4	14.3	41.1	.5	10.8	8.5	1.3	68.9	9.2
4	36.2	11.9	31.7	32.3	12.5	25.0	2.1	10.6	7.6	2.1	75.8	12.9
5	75.2	12.2	55.5	76.6	12.3	23.5	3.2	8.7	6.0	3.6	59.8	11.7
6	73.2	10.4	269.6	53.5	9.8	16.2	6.4	8.5	9.6	6.0	94.2	10.9
7	51.7	10.6	426.4	40.4	68.8	12.3	13.2	9.3	8.8	6.1	55.1	13.8
8	35.2	11.0	189.2	39.0	41.9	11.1	11.7	8.9	8.1	4.8	77.4	9.3
9	31.7	11.5	114.4	44.3	26.6	12.2	11.9	8.3	8.3	9.6	56.9	10.2
10	22.9	11.8	111.7	42.8	17.4	9.2	9.8	7.0	8.2	34.7	54.3	11.8
11	27.8	11.0	145.3	33.5	14.9	8.2	8.3	7.3	8.9	46.7	39.3	13.8
12	20.3	11.0	164.8	28.9	13.2	5.3	10.7	7.3	6.5	42.9	29.6	125.9
13	18.9	10.2	99.3	26.9	8.7	4.2	8.2	7.8	8.5	28.3	29.4	257.9
14	18.5	11.0	83.7	22.6	9.0	4.8	12.1	7.1	7.8	32.0	34.1	141.4
15	19.1	10.8	50.6	20.2	6.8	3.6	9.4	7.3	6.3	23.1	31.9	90.4
16	47.7	11.5	60.5	19.3	5.2	2.3	11.2	6.9	6.5	17.3	52.1	63.4
17	33.4	10.2	33.2	15.7	4.1	2.1	11.1	6.6	6.6	9.7	72.5	93.3
18	27.0	12.4	45.1	14.6	4.2	2.1	10.1	7.4	5.1	9.0	51.1	67.7
19	30.0	19.6	84.5	12.2	5.5	2.0	10.1	8.7	5.5	11.9	51.8	53.8
20	17.4	19.8	65.4	14.0	5.6	5.3	12.0	12.2	10.1	7.0	23.7	34.4
21	14.2	17.1	52.9	74.1	4.1	11.1	9.5	13.5	12.2	6.2	25.6	29.8
22	14.8	15.1	50.4	109.3	3.9	9.3	12.8	12.6	9.5	7.4	26.8	30.2
23	20.7	14.3	173.5	109.7	3.7	5.1	11.9	13.6	3.8	5.5	22.8	15.1
24	27.4	13.5	107.8	115.0	3.9	6.0	10.3	13.4	5.3	4.3	34.3	13.4
25	57.0	10.7	70.3	72.7	12.8	2.8	5.7	11.0	4.3	5.2	31.9	12.3
26	30.7	9.9	58.3	53.2	174.1	1.8	6.0	10.2	3.5	5.3	24.6	11.3
27	26.5	9.2	42.8	33.9	12.8	1.8	4.1	10.2	4.0	4.1	24.3	9.9
28	20.0	8.7	35.5	26.1	12.9	1.8	9.9	10.2	2.6	4.7	19.4	10.4
29	17.6	.....	29.7	25.9	37.0	1.7	9.4	10.2	1.7	5.9	15.2	12.3
30	16.8	.....	22.4	21.7	24.3	1.7	9.4	10.2	1.7	3.7	12.8	11.2
31	17.0	.....	22.8	.....	21.5	.....	9.5	9.7	.....	4.0	.....	10.2

Estimated monthly discharge of Quackenkill Creek at Quackenkill village, N. Y.

[Drainage area, 18.5 square miles.]

Month.	Mean discharge.	Run-off.	
		Second-feet per square mile.	Depth in inches.
1894.	*Sec.-feet.*		
January	30.0	1.62	1.87
February	12.3	.66	.69
March	88.5	4.56	5.24
April	41.7	2.25	2.51
May	19.7	1.65	1.90
June	10.5	.56	.62
July	8.4	.43	.49
August	9.4	.51	.59
September	6.8	.37	.41
October	11.4	.62	.71
November	42.5	2.29	2.55
December	39.4	2.13	2.45
The year	26.7	1.47	20.03

STREAMS PROPOSED AS SOURCES OF PUBLIC WATER SUPPLY FOR NEW YORK CITY.

In July, 1901, gaging stations were established and a series of discharge measurements undertaken on streams in the Catskill Mountain region and vicinity in cooperation with the department of water supply of New York City. In the following table the drainage area of the several streams are given:

Drainage area of streams proposed as sources of water supply for New York City.

Stream.	Location of gaging station.	Drainage area.		
		Above proposed reservoir.	Above gaging station.	Above mouth.
		Sq. miles.	*Sq. miles.*	*Sq. miles.*
Tenmile River	Dover Plains, N. Y.	200	195	195
Housatonic River	Gaylordsville, Conn.	1,020	1,020	1,580
Catskill Creek	South Cairo, N. Y.	140	260	394
Esopus Creek	Kingston, N. Y.	242	312	417
Wallkill River	Newpaltz, N. Y.	464	735	779
Rondout Creek	Rosendale, N. Y.	184	365	[a] 369
Fishkill Creek	Glenham, N. Y.	158	198	204

[a] Above junction with Wallkill River.

A gaging station on Housatonic River at Gaylordsville, Conn., established October 23, 1900, by the United States Geological Survey is also included.

ESOPUS CREEK AT KINGSTON, N. Y.

This gaging station is located at the Washington avenue bridge in Kingston, and was established July 5, 1901. The drainage basin is described and results of discharge measurements and gage readings for 1901 are given in Water-Supply Paper No. 65, pages 63 to 66. The maximum observed gage heights have been as follows:

Gage heights of Esopus Creek at Kingston.

Date.	A. M.	M.	P. M.
1901.			
December 15	20.0		22.75
December 16	17.0		13.4
1902.			
January 22			16.15
March 1	20.45		19.75
March 2	16.1		17.52
March 3	17.25		
March 17	18.3	20.15	18.22
September 29	20.75		24.1
September 30	18.8		15.9
December 17	16.8		

The following table gives a list of the discharge measurements made on Esopus Creek at Kingston, N. Y., during 1902:

Discharge measurements of Esopus Creek at Kingston, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
June 16	W. W. Schlecht	4.48	135.8
September 4	H. K. Barrows	4.49	133.0
August 21	do	4.94	191.0
June 26	W. W. Schlecht	5.02	225.0
June 5	do	5.03	234.5
July 16	H. K. Barrows	5.13	268.8
November 22	F. H. Tillinghast	5.45	272.0
July 9	Barrows and Schlecht	5.81	450.4
May 14	W. W. Schlecht	5.83	422.0
September 23	P. M. Churchill	5.87	449.0
November 11	F. H. Tillinghast	6.00	416.0
August 12	H. K. Barrows	6.28	550.0
May 24	W. W. Schlecht	6.38	[a]274.0
June 5	do	6.41	[a]272.0
November 5	F. H. Tillinghast	6.55	594.0
April 23	W. W. Schlecht	6.94	828.3
May 14	do	7.14	[a]508.0
July 30	H. K. Barrows	7.65	1,155.0
July 24	do	8.11	1,348.0
October 4	P. M. Churchill	9.32	1,890.0
March 12	Horton and Schlecht	9.90	2,843.0
April 30	W. W. Schlecht	10.28	2,813.0
December 18	F. H. Tillinghast	13.00	3,416.0
April 10	W. W. Schlecht	13.37	5,021.0
December 22	F. H. Tillinghast	16.00	8,594.0
March 1	W. W. Schlecht	20.38	[b]12,620.0

[a] Measured at Glasgow Bridge, Glenerie.
[b] Large quantities of floating ice in the stream. Surface velocities used.

The following measurements were also made during the period of ice obstruction, by W. W. Schlecht:

February 20: Gage height, 5.38; discharge, 245 second-feet; river partly frozen over.

February 15: Gage height, 5.60; discharge, 337 second-feet; river mostly frozen over.

February 7: Gage height, 6.83; discharge, 530 second-feet; river partly frozen.

September 29, 1.30 p. m.: The stream attained a flood stage, giving a reading of 25.25 on the gage.

Mean daily gage height, in feet, of Esopus Creek at Kingston, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	8.20	7.25	20.10	9.35	8.95	4.85	6.38	7.09	4.45	13.38	7.28	5.9
2	10.35	7.45	16.82	8.69	8.18	4.83	6.19	7.95	4.48	11.68	6.75	5.7
3	9.95	9.35	15.75	8.05	7.78	4.76	6.00	7.10	4.43	10.10	5.83	6.19
4	8.40	7.72	11.07	7.64	7.70	4.83	6.40	6.90	4.33	9.50	6.55	6.43
5	7.65	7.52	9.45	7.33	7.43	4.70	5.99	6.53	4.38	8.60	6.55	6.33
6	7.30	7.16	8.95	7.03	7.11	4.73	6.19	7.08	4.33	9.64	6.25	6.18
7	6.95	6.70	7.90	7.18	6.98	4.55	6.16	6.90	4.38	8.68	6.47	6.35
8	6.65	6.47	7.68	7.28	6.74	4.63	6.03	3.43	4.38	8.18	6.35	6.6
9	6.50	6.14	8.85	13.10	6.55	4.63	5.80	6.18	4.38	7.85	6.13	6.45
10	6.40	6.25	9.20	13.86	6.40	4.68	5.58	5.88	7.68	7.40	6.08	6.00
11	6.35	5.94	9.05	11.60	6.23	4.58	5.50	5.83	6.00	7.15	7.85	6.35
12	5.88	5.88	9.80	10.22	6.10	4.45	5.34	6.25	5.49	9.10	5.95	6.55
13	6.00	5.77	11.85	9.41	5.96	4.53	5.15	5.73	5.53	8.47	5.85	6.35
14	5.93	5.60	11.82	8.78	5.88	4.58	5.05	5.58	6.18	8.00	5.78	6.4
15	5.60	5.58	9.98	8.25	5.70	4.40	4.98	5.38	5.85	7.60	5.73	6.43
16	5.58	5.53	9.33	7.90	5.70	4.46	4.99	5.30	5.53	7.33	5.63	6.65
17	5.59	5.63	[a]18.28	7.58	5.50	4.78	4.89	5.08	5.30	7.15	5.60	16.20
18	5.30	5.39	13.10	7.35	5.33	4.94	4.80	5.10	5.13	6.95	5.60	12.86
19	5.50	5.45	10.13	7.10	5.38	4.63	4.78	4.98	5.08	6.75	5.54	11.00
20	5.86	5.30	9.20	6.93	5.40	4.60	6.37	4.98	5.30	6.73	5.46	9.95
21	4.95	5.35	8.62	6.80	5.28	4.81	10.60	4.88	6.88	6.47	5.45	8.55
22	12.73	5.36	8.25	6.78	5.13	5.55	9.50	4.85	6.28	6.30	5.38	15.6
23	10.88	5.30	8.20	6.93	5.03	5.13	9.28	4.78	5.88	6.20	5.36	12.80
24	8.88	5.36	7.87	6.88	5.00	4.93	8.38	4.65	5.68	6.13	5.36	10.40
25	8.00	5.39	7.63	6.58	4.88	4.81	8.58	4.70	5.68	6.30	5.2	9.35
26	7.53	6.45	7.43	6.36	5.20	4.93	8.68	4.65	7.00	5.87	5.3	8.7
27	8.63	9.30	7.28	6.35	5.20	5.15	8.01	4.55	10.35	5.78	6.0	8.28
28	8.08	9.37	7.19	6.20	5.58	4.84	7.75	4.65	9.48	7.83	6.6	8.75
29	7.72	.....	11.65	5.98	5.25	4.81	7.19	4.70	[b]22.43	8.35	6.1	9.10
30	7.82	.....	12.55	9.81	5.03	7.10	7.68	4.60	17.35	7.75	5.88	8.97
31	7.48	.....	10.45	.....	5.03	.....	7.35	4.63	.....	7.50	.....	8.05

[a] Highest water at 1.30 p. m., 18.30. [b] Highest water at 1.30 p. m., 25.25.

CATSKILL CREEK AT SOUTH CAIRO, N. Y.

This stream is described and the results of current-meter measurements, together with daily gage heights of 1901, are given in Water-Supply Paper No. 65, pages 61 to 63. In relation to the supply available for storage in the proposed reservoirs, the maximum discharge of these streams is of interest. The following table shows a number of the maximum gage readings of 1901, also of 1902. This, in connection

with the accompanying table of discharge measurements, will serve to illustrate the freshet flow of this stream:

Gage heights of Catskill Creek, in feet, at South Cairo, N. Y., during freshets.

Date.	A. M.	P. M.
1901.		
December 15	15.0	10.6
1902.		
February 28		12.2
March 1	11.5	11.7
April 9	11.7	11.6

The following table gives a list of the discharge measurements made on Catskill Creek at South Cairo, N. Y., during 1902:

Discharge measurements of Catskill Creek at South Cairo, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Sec.-feet.*
June 13	W. W. Schlecht	2.69	40.6
June 24	do	2.70	43.5
August 27	H. K. Barrows	2.74	39.4
September 5	do	2.79	50.0
June 3	W. W. Schlecht	2.82	49.5
May 23	do	2.83	51.1
September 22	P. M. Churchill	3.32	121.0
July 9	H. K. Barrows	3.365	113.5
May 10	W. W. Schlecht	3.47	133
August 13	H. K. Barrows	3.49	135
November 7	F. H. Tillinghast	3.80	235
December 3	do	3.90	275
October 10	P. M. Churchill	3.92	242
April 22	W. W. Schlecht	4.06	320.2
August 2	H. K. Barrows	5.36	1,005
December 18	F. H. Tillinghast	5.45	1,054
July 23	H. K. Barrows	6.11	1,602
April 11	W. W. Schlecht	6.86	2,312
March 13	Horton and Schlecht	8.66	5,483

A measurement made February 27, 1902, with the stream obstructed by ice, showed the discharge to be 363 second-feet, gage height 4.72. The stream was frozen from bank to bank, to a depth of 6 to 18 inches.

Mean daily gage height, in feet, of Catskill Creek at South Cairo, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	.....	4.30	11.70	5.35	4.10	2.95	3.48	4.50	2.90	6.18	4.30	3.6
2	.....	5.05	9.68	5.88	3.95	2.88	3.28	5.58	2.83	5.63	4.15	3.63
3	.....	5.20	6.70	4.95	3.93	2.80	3.13	4.38	2.75	5.20	4.05	3.8
4	.....	4.45	6.80	4.88	3.88	2.83	3.10	4.13	2.73	4.80	3.95	4.18
5	4.40	4.40	6.35	4.90	3.83	2.88	3.08	3.85	2.73	4.60	3.90	4.0
6	4.20	4.40	5.40	4.65	3.78	2.88	4.45	4.45	2.70	4.53	3.83	4.0
7	4.05	4.30	4.10	4.40	3.73	2.85	4.20	4.20	2.73	4.40	3.77	3.93
8	4.80	4.25	4.10	4.60	3.70	2.90	3.48	3.93	2.78	4.23	3.73	3.8
9	3.70	4.20	4.30	11.65	3.60	2.80	3.80	3.80	2.90	4.05	3.65	3.7
0	3.55	4.25	5.20	8.25	3.50	2.75	3.65	3.65	3.68	3.90	3.55	4.05
1	3.40	4.40	5.75	6.98	3.40	2.70	3.60	3.55	3.55	3.93	3.5	4.4
2	3.30	4.50	9.10	6.48	3.30	2.65	3.55	3.55	3.28	5.08	3.55	4.13
3	3.30	4.70	9.20	5.50	3.28	2.78	2.95	3.45	3.40	4.60	3.63	4.0
4	3.30	4.95	7.50	4.95	3.23	2.75	2.80	3.15	3.53	4.25	3.53	4.0
5	3.20	3.10	5.45	4.78	3.20	2.70	2.80	3.20	3.35	4.15	3.5	3.95
6	3.30	3.20	7.40	4.58	3.05	2.75	2.75	3.15	3.18	4.25	3.4	4.53
7	3.20	3.40	9.43	4.35	3.00	2.90	2.70	3.05	3.05	3.93	3.4	6.35
8	3.00	3.50	6.85	4.25	2.95	2.88	2.65	2.93	2.95	3.83	3.33	5.43
9	2.90	3.60	4 15	4.20	2.90	2.78	2.70	3.05	2.98	3.80	3.3	5.0
0	2.90	3.80	4.59	4.20	2.95	2.85	4.40	3.10	3.25	3.83	3.28	4.80
1	3.10	3.80	4.00	4.13	2.93	2.80	7.25	3.03	3.48	3.73	3.30	6.65
2	9.85	3.80	4.55	4.10	2.83	2.80	6.50	2.98	3.58	3.73	3.2	8.48
3	5.90	3.50	5.58	4.03	2.78	2.80	6.53	2.93	3.18	3.60	3.2	6.7
4	4.80	3.20	5.48	3.95	2.90	2.78	6.18	2.83	3.10	3.63	3.15	5.13
5	4.40	3.40	5.05	3.90	2.95	2.70	7.08	2.75	3.25	3.60	3.2	4.85
6	4.03	3.50	4.93	3.80	2.85	2.68	.....	2.70	3.58	3.50	3.3	6.65
7	3.85	4.83	4.83	3.83	3.10	2.65	4.05	2.70	4.35	3.55	3.85	4.35
8	3.58	9.15	5.03	3.73	3.33	2.60	4.20	2.73	[a]4.70	5.90	4.13	4.20
9	3.70	.....	5.73	3.95	3.25	2.80	4.40	2.85	9.95	5.30	3.8	4.13
0	4.25	.....	5.93	4.10	3.13	3.88	4.38	2.98	7.20	4.70	3.63	3.95
1	4.30	.....	5.43	.....	3.00	.....	4.25	3.08	.....	4.45	.....	3.85

[a] Gage height at 12 p. m. = 16.1 feet.

RONDOUT CREEK AT ROSENDALE, N. Y.

This station was established at the highway bridge in Rosendale, ; miles above the junction of Rondout Creek and Wallkill River, 'uly 6, 1901. The station is described and results of gagings for 1901 ıre given in Water-Supply Paper No. 65, pages 66 to 68. Gage readıngs taken during the extreme freshets of December 15, 1901, and Iarch 1, 1902, are as follows:

Iage heights of Rondout Creek at Rosendale, N. Y., during freshets of December 15, 1901, and March 1, 1902.

Date.	A. M.	M	P. M.
1901.			
Iecember 15	15.75	16.7	17.8
1902.			
Iarch 1	17.4	.....	17

The following table gives the discharge measurements made on Rondout Creek at Rosendale, N. Y., during 1902:

Discharge measurements of Rondout Creek at Rosendale, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
September 25	P. M. Churchill	6.31	167.0
July 15	H. K. Barrows	6.33	141.9
July 18	do	6.33	137.2
August 29	do	6.33	145.0
June 6	W. W. Schlecht	6.38	163.0
June 20	do	6.42	166.0
November 21	F. H Tillinghast	6.55	283.4
December 2	do	6.70	367.0
April 28	W. W. Schlecht	6.83	382.0
May 12	do	6.85	421.0
November 4	F. H. Tillinghast	7.00	570.0
August 7	H. K. Barrows	7.39	838.0
July 29	do	7.40	888.0
March 21	W. W. Schlecht	8.07	1,529.0
March 1	do	17.60	13,956.0
April 11	do	11.78	5,665.0
December 17	F. H. Tillinghast	12.80	7,928.0

Additional measurements were made by W. W. Schlecht while the river was frozen over, as follows:

February 18: Gage height, 7.70; discharge, 342 second-feet. The river was frozen over from bank to bank and slush had collected below the ice.

February 26: Gage height, 8.13; discharge, 543 second-feet. Slush below the ice made an unsatisfactory record.

February 26: Gage height, 8.43; discharge, 684 second-feet. Ice covered the river from bank to bank and slush had collected underneath.

Mean daily gage height, in feet, of Rondout Creek at Rosendale, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	8.73	8.98	17.20	8.18	8.25	6.58	7.08	7.70	6.25	10.03	7.25	6.73
2	7.90	8.95	14.23	7.85	7.70	6.48	6.90	8.35	6.20	9.28	7.05	6.70
3	7.90	9.75	12.53	7.58	7.70	6.55	6.98	7.60	6.13	8.43	7.03	6.90
4	7.90	9.35	9.75	7.58	7.75	6.63	7.70	7.28	6.15	7.90	7.00	7.20
5	7.90	9.70	8.70	7.35	7.50	6.48	7.23	7.08	6.10	7.80	6.90	6.88
6	7.83	9.25	8.05	7.25	7.33	6.40	7.13	7.25	6.18	8.78	6.87	6.80
7	7.58	9.00	7.95	7.60	7.28	6.48	7.00	7.33	6.20	8.00	6.95	6.95
8	7.28	8.83	7.65	8.10	7.15	6.45	6.88	7.03	6.20	7.65	6.85	6.98
9	7.13	8.58	9.40	12.28	7.03	6.48	6.85	6.93	6.23	7.38	6.80	6.88
10	7.08	8.05	9.70	11.40	6.93	6.38	6.68	6.83	7.00	7.18	6.78	7.10
11	7.10	8.18	9.30	9.75	6.88	6.30	6.58	6.80	6.58	6.95	6.73	7.08
12	7.35	8.05	9.70	9.15	6.88	6.35	6.53	6.90	6.40	9.75	6.73	7.00
13	6.95	7.98	11.05	8.63	6.83	6.35	6.50	6.80	6.45	8.65	6.73	6.95
14	6.73	7.88	10.15	8.15	6.68	6.38	6.45	6.70	6.68	8.00	6.70	7.15
15	6.83	7.80	9.15	7.85	6.63	6.35	6.35	6.55	6.48	7.57	6.70	7.50
16	6.90	7.65	8.80	7.65	6.70	6.35	6.40	6.58	6.35	7.35	6.70	8.35
17	6.78	7.53	13.10	7.50	6.60	6.50	6.33	6.50	6.25	7.23	6.65	12.95
18	6.70	7.60	9.95	7.38	6.63	6.45	6.30	6.45	6.20	7.07	6.65	10.00
19	6.78	7.35	8.65	7.25	6.60	6.30	6.33	6.40	6.18	7.07	6.68	8.80
20	6.70	7.43	8.25	7.18	6.60	6.43	7.53	6.40	6.25	7.00	6.65	8.30
21	6.73	7.43	8.08	7.10	6.58	6.43	8.93	6.38	6.50	6.95	6.65	8.35
22	14.68	7.40	8.00	7.05	6.50	7.10	9.18	6.48	6.40	6.90	6.65	13.45
23	9.83	7.43	7.88	7.00	6.48	6.70	8.38	6.40	6.23	6.80	6.60	10.58
24	8.35	7.48	7.80	6.90	6.45	6.50	[a]9.94	6.40	6.25	6.80	6.60	9.55
25	7.85	7.55	7.63	6.88	6.40	6.40	10.34	6.33	6.45	6.80	6.55	8.50
26	7.68	8.23	7.45	6.98	6.80	6.43	8.95	6.30	9.40	6.73	6.70	8.10
27	8.95	10.68	7.38	6.95	6.88	6.50	8.23	6.28	9.75	6.63	6.75	8.87
28	7.75	12.10	7.33	6.83	7.20	6.43	7.80	6.25	8.68	9.38	6.90	7.45
29	8.00	.....	9.85	6.78	6.85	6.45	7.38	6.33	[b]14.90	8.60	6.88	7.27
30	8.18	.....	9.53	9.38	6.60	7.70	7.80	6.30	10.78	7.83	6.80	7.20
31	8.60	.....	8.63	.....	6.63	.....	7.33	6.30	.....	7.45	.....	7.20

[a] Highest water, 12.65, at 7 p. m. [b] Highest water, 15.6, at 3 p. m.

DELAWARE AND HUDSON CANAL AT CREEKLOCKS, N. Y.

The Delaware and Hudson Canal runs parallel to Rondout Creek from the feeder dam below High Falls to tide water at Eddyville. The canal receives its entire water supply from Rondout Creek. The section from High Falls to Eddyville is the only portion of the canal remaining in operation in New York State. At Rosendale the canal carries a portion of the yield of Rondout Creek past the gaging station. In order to determine the run-off from Rondout Creek drainage basin, gagings of the flow in the Delaware and Hudson Canal at the foot of the Rosendale level have been undertaken. The diversion to the canal added to the measured discharge of Rondout gaging station represents the total flow from the drainage basin. The gaging station at Creeklocks is described in Water-Supply Paper No. 65, pages 68 to 69. The accompanying table shows the estimated daily and mean monthly diversion during 1902.

Estimated diversion, in second-feet, from Rondout Creek to Delaware and Hudson Canal, Rosendale, N. Y.

Day	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902										
1	.....	15.5	22.6	.....	24.2	26.0	.....	22.6	22.5	24.5
2	.....	17.7	15.0	25.2	23.8	25.6	25.3	22.4	.....	20.8
3	.....	21.5	24.6	20.8	23.1	.....	22.5	26.1	21.0	22.3
4	.....	22.0	.....	11.6	.....	23.8	24.3	25.8	23.5	21.5
5	.....	17.9	27.6	25.3	24.1	24.5	25.3	.....	21.5	22.7
6	.....	.....	23.1	19.5	.....	22.5	25.8	22.2	23.3	[a] 19.0
7	.....	20.4	24.8	21.8	23.1	24.5	.....	23.1	24.2	.....
8	.....	20.2	24.3	.....	22.7	23.8	25.0	22.4	24.8	.....
9	.....	18.4	24.6	23.8	24.3	24.0	23.5	21.9	.....	.....
10	.....	14.3	24.5	35.9	25.3	.....	24.3	22.8	22.8	.....
11	.....	20.7	.....	24.9	26.1	24.0	24.3	22.1	21.7	.....
12	.....	19.2	24.3	33.8	21.8	24.5	25.1	.....	.....	.....
13	.....	.....	24.1	27.5	.....	24.6	22.2	20.4	21.2	.....
14	.....	25.4	25.0	23.6	25.3	26.0	.....	20.6	23.0	.....
15	.....	25.7	24.1	.....	25.3	24.8	26.5	20.5	23.3	.....
16	.....	24.2	24.5	22.3	24.2	24.5	25.6	19.5	.....	.....
17	.....	25.1	22.8	22.6	26.0	.....	25.8	19.5	21.6	.....
18	.....	26.1	.....	24.3	25.1	25.5	23.3	19.7	24.8	.....
19	.....	25.6	24.3	23.8	22.7	24.3	24.8	.....	23.8	.....
20	.....	.....	24.6	23.9	.....	23.8	22.0	21.3	20.4	.....
21	.....	25.9	23.1	24.4	23.8	25.1	.....	23.5	26.0	.....
22	.....	26.7	23.6	.....	25.6	25.6	24.3	21.0	21.8	.....
23	15.8	24.1	25.6	22.1	22.8	24.3	23.8	21.2	.....	.....
24	11.4	23.3	24.3	20.1	20.6	.....	24.0	23.0	23.0	.....
25	12.3	23.4	.....	22.6	19.0	22.8	25.1	20.4	21.2	.....
26	15.3	22.8	21.1	22.8	22.8	22.2	22.8	.....	20.7	.....
27	16.9	.....	28.0	19.8	.....	25.1	22.6	22.8	22.7	.....
28	16.4	27.1	26.5	22.6	25.6	22.5	.....	23.8	24.8	.....
29	.....	25.2	26.3	.....	21.6	25.8	20.3	24.3	22.5	.....
30	.....	25.8	20.7	26.7	23.6	23.0	22.1	23.0	.....	.....
31	21.8	.....	24.1	.....	26.4	.....	.....	25.0	.....	.....
Mean	.....	22.5	24.0	23.7	23.8	24.3	24.0	22.2	.....	.....

[a] Close of navigation.

RONDOUT CREEK AT HONK FALLS, N. Y.

This gaging station is described in Water-Supply Paper No. 65, pages 69 to 70. Automatic recording gages have been erected at the dam and power house. The gages furnish continuous graphical charts, showing the depth wasted over the dam and the flow over a weir situated in the tailrace of the power house of the Honk Falls Light and Power Company. The discharge has not been estimated.

WALLKILL RIVER AT NEWPALTZ, N. Y.

Wallkill River rises in the northern highlands of New Jersey. The greater portion of its course lies through New York State, and it is tributary to the Hudson River through Rondout Creek. The gaging station at Newpaltz, which was established July 7, 1901, is described in Water-Supply Paper No. 65, pages 71 to 74. The drainage basin is less precipitous than that of other streams in southeastern New York. Wallkill River, however, closely resembles Catskill and Esopus

creeks in the torrential character of its run-off, being subject to sudden and extreme variations in flow. The maximum gage readings have been as follows:

Maximum gage heights of Wallkill River at Newpaltz.

Date.	A. M.	P. M.
1901.	*Feet.*	*Feet.*
December 15	13.5	13.1
December 30	18.0	20.5
December 31	19.7	18.7
1902.		
March 1	22.4	24.65
March 2	23.6	24.0
March 3	24.8	24.5
December 22	17.4	20.6
December 23	20.6	18.7

The following table gives a list of the discharge measurements made on the Wallkill River at Newpaltz, N. Y., during 1902:

Discharge measurements of Wallkill River at Newpaltz, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
July 17	H. K. Barrows	5.70	124.3
August 28	do	5.86	169.0
September 18	Barrows and Churchill	5.96	209.5
June 19	W. W. Schlecht	6.18	295.0
May 21	do	6.33	344.0
June 6	do	6.40	381.0
November 18	F. H. Tillinghast	6.62	550.0
May 13	W. W. Schlecht	6.68	506.0
August 15	H. K. Barrows	6.72	518.0
December 2	F. H. Tillinghast	6.80	626.0
April 26	W. W. Schlecht	6.92	680.0
February 24	do	7.33	[a] 288.0
July 29	H. K. Barrows	7.49	942.0
April 21	W. W. Schlecht	7.57	1,028.0
February 10	do	7.78	[b] 597.0
November 4	F. H. Tillinghast	7.95	1,165.0
August 6	H. K. Barrows	7.98	1,150.0
May 1	W. W. Schlecht	10.264	2,623.0
April 9	do	13.21	5,354.0
March 11	do	15.93	7,140.0

[a] Measured through ice 1 foot and 6 inches to 2 feet and 6 inches in thickness.
[b] Measured through ice 1 foot to 2 feet in thickness.

Mean daily gage height, in feet, of Wallkill River at Newpaltz, N. Y.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1902.												
1	15.15	8.75	23.53	9.35	10.25	7.50	7.25	9.50	6.10	10.25	8.65	6.8
2	13.10	8.75	23.80	8.95	8.95	7.25	7.15	9.10	6.05	10.85	8.35	6.7
3	12.95	10.65	[a]24.65	8.65	9.15	7.05	7.80	8.75	6.60	10.15	8.15	7.5
4	12.10	9.70	22.75	8.20	8.85	6.90	7.58	8.60	5.88	9.65	7.95	7.9
5	10.45	9.75	20.25	8.00	8.35	6.55	7.08	8.30	5.78	9.60	7.65	8.1
6	10.70	8.90	15.20	9.70	7.95	6.35	6.78	7.95	5.70	10.10	7.50	8.5
7	10.20	8.15	13.20	7.70	7.50	6.30	6.53	7.85	5.60	9.45	7.50	8.1
8	9.70	7.85	12.70	8.40	7.45	6.25	6.35	7.65	5.50	9.00	7.65	7.7
9	9.15	7.78	14.95	[b]13.65	7.35	6.30	6.23	7.30	5.50	8.55	7.15	7.7
10	8.85	7.70	16.45	13.50	7.10	6.50	6.32	7.05	6.10	8.40	6.95	7.6
11	8.75	7.55	15.90	12.20	6.80	6.35	6.00	6.90	6.45	8.25	6.75	7.0
12	8.20	7.55	16.10	11.65	6.65	6.30	6.00	6.80	6.30	12.45	6.7	7.0
13	8.05	7.40	17.05	10.65	6.60	6.20	5.90	6.75	6.35	11.90	6.6	7.5
14	8.05	7.35	[c]16.50	9.80	6.55	6.15	5.78	6.68	6.45	10.50	6.6	7.5
15	8.00	7.15	15.00	9.35	6.50	6.10	5.70	6.60	6.25	9.70	6.6	7.5
16	8.00	7.10	14.65	8.65	6.45	6.20	5.70	6.53	6.15	9.35	6.5	7.5
17	7.70	7.20	15.40	8.20	6.45	6.25	5.73	6.43	6.05	9.00	6.5	12.2
18	7.55	7.15	13.75	8.00	6.30	6.15	5.58	6.38	5.95	8.60	6.5	12.2
19	7.50	7.08	11.75	7.85	6.30	6.13	5.55	6.28	5.80	8.60	6.5	12.3
20	7.20	7.00	10.50	7.60	6.30	6.10	6.10	6.20	5.90	8.15	6.5	12.3
21	7.20	7.05	10.30	7.45	6.30	6.13	7.50	6.30	5.90	7.95	6.4	12.9
22	18.50	7.05	10.20	7.35	6.30	6.33	8.65	6.10	5.90	7.65	6.4	19.0
23	17.65	7.10	9.75	7.15	6.25	6.40	7.40	6.05	5.90	7.47	6.65	19.0
24	13.55	7.25	9.60	7.10	6.20	6.35	[c]10.70	6.10	5.90	7.37	6.3	17.3
25	13.15	7.30	9.45	6.95	6.20	6.20	[d]14.00	6.05	6.15	7.15	6.3	16.2
26	12.20	7.75	9.00	6.85	6.45	6.20	9.10	6.00	9.65	6.95	6.35	15.3
27	12.85	11.40	8.50	7.00	8.30	6.10	8.50	6.00	12.00	6.85	6.35	14.2
28	12.65	12.75	8.20	6.45	9.20	6.25	7.80	5.95	11.90	11.65	6.35	14.2
29	11.06	.....	10.20	6.65	8.40	6.35	7.45	8.25	13.45	11.25	7.1	13.8
30	9.50	.....	11.05	[e]11.75	8.30	7.00	7.45	7.25	10.35	9.45	6.95	12.3
31	9.25	.....	9.90	.....	7.90	.....	8.45	6.40	.....	8.95	.....	11.7

[a] Highest water 24.80 at (?) p. m.
[b] Highest water 14.6 at (?) p. m.
[c] Highest water 15.4 at 8 p. m.
[d] Highest water 16.6 at 9 p. m.
[e] Highest water 12.6 at p. m.

FISHKILL CREEK AT GLENHAM, N. Y.

The gaging station is located at the Newburg, Dutchess and Connecticut Railroad bridge in Glenham. It was established July 8, 1901, and is described in Water-Supply Paper No. 65, pages 74 to 76, where discharge measurements and gage heights for 1901 may be found.

The following table gives a list of the discharge measurements made on the Fishkill Creek at Glenham, N. Y., during 1902:

Discharge measurements of Fishkill Creek at Glenham, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Sec. feet.*
August 26	H. K. Barrows	3.04	48.5
July 14	do	3.18	64.4
August 11	do	3.51	115.0
November 25	F. H. Tillinghast	3.65	146.0
October 11	P. M. Churchill	3.71	155.0
June 2	W. W. Schlecht	3.785	132.3
July 28	H. K. Barrows	3.90	200.0
June 17	W. W. Schlecht	4.00	212.5
November 8	F. H. Tillinghast	4.00	233.0
April 25	W. W. Schlecht	4.03	[a] 152.4
May 6	do	4.46	349.5
February 11	do	4.87	[b] 202.5
October 30	C. C. Covert	4.97	697.7
April 12	W. W. Schlecht	5.30	772.6
March 5	do	5.79	1,129.0

[a] Probably incorrect.

[b] Ice along banks at gaging station, frozen from bank to bank 90 yards below station, 2 to 9 inches thick.

Mean daily gage height, in feet, of Fishkill Creek at Glenham, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	6.05	5.00	13.00	4.90	5.48	3.83	3.70	3.80	2.90	4.25	4.40	3.7
2	5.65	4.75	10.00	4.78	4.93	3.70	3.53	3.70	2.80	4.20	4.33	3.7
3	5.50	5.63	8.78	4.68	4.70	3.60	3.45	3.60	2.95	4.00	4.20	3.8
4	5.30	5.55	6.70	4.60	4.73	3.70	3.85	3.60	2.73	3.83	4.15	4.0
5	5.18	5.58	5.80	4.53	4.63	3.70	3.60	3.50	2.90	3.83	4.05	3.9
6	4.95	5.28	4.95	4.45	4.45	3.55	3.70	3.43	2.95	4.20	4.03	3.7
7	4.80	5.25	5.05	4.53	4.35	3.50	3.70	3.48	2.90	4.20	4.00	3.7
8	4.70	5.00	5.15	4.63	4.30	3.85	3.55	3.40	2.95	3.93	4.00	3.8
9	4.65	5.18	5.90	5.13	4.20	3.85	3.45	3.40	3.00	3.85	3.93	3.9
10	4.63	5.05	7.75	5.65	4.10	3.75	3.38	3.30	3.33	3.78	3.9	4.0
11	4.60	4.75	6.95	5.53	3.90	3.60	3.40	3.50	3.25	3.70	3.88	3.8
12	4.58	4.80	6.50	5.28	3.98	3.50	3.30	3.85	3.08	4.95	3.88	3.9
13	4.75	4.60	6.70	5.05	3.95	3.40	3.23	3.65	3.30	5.03	3.88	4.0
14	5.00	4.40	6.63	4.90	3.90	3.43	3.20	3.48	3.23	4.08	3.88	4.
15	4.70	4.33	5.98	4.80	3.90	3.50	3.13	3.40	3.20	4.35	3.8	4.
16	4.35	4.25	5.65	4.70	3.90	3.50	3.13	3.35	3.15	4.20	3.83	4.
17	4.28	4.48	6.73	4.60	3.80	3.95	3.10	3.28	3.15	4.80	3.8	6.
18	4.25	4.38	6.45	4.58	3.70	3.70	3.10	3.20	3.18	4.00	3.7	7.
19	4.25	4.33	5.70	4.50	3.75	3.50	3.08	3.20	3.00	4.00	3.7	6.
20	4.18	4.35	5.20	4.40	3.80	3.53	3.20	3.15	3.05	3.95	3.68	5.
21	4.18	4.38	5.30	4.35	3.83	3.50	4.15	3.10	3.03	3.90	3.63	5.
22	5.88	4.85	5.23	4.30	3.68	3.75	4.70	3.15	3.15	3.80	3.6	7.
23	6.55	4.85	5.13	4.23	3.68	3.60	4.65	3.10	3.08	3.80	3.6	8.
24	5.15	4.90	5.00	4.15	3.60	3.50	4.10	3.10	3.13	3.70	3.63	7.
25	4.75	4.70	4.85	4.05	3.60	3.40	4.18	3.15	2.95	3.75	3.63	5.
26	4.63	4.85	4.75	4.05	4.20	3.50	4.10	3.05	3.48	3.73	3.68	5.
27	5.00	5.88	4.70	4.13	4.15	3.40	4.05	3.00	3.60	3.70	3.95	5.
28	5.00	7.10	4.55	4.08	4.58	3.30	3.90	3.00	3.60	4.65	3.88	5.
29	4.95	.....	4.85	4.00	4.23	3.35	3.80	2.95	4.80	5.43	3.8	4
30	5.05	.....	5.40	4.83	4.03	4.08	4.20	2.95	4.75	4.93	3.7	4
31	4.95	.....	5.05	.....	3.90	.....	3.95	2.90	.....	4.55	.....	4

The freshet of March 1, 1902, exceeded all previous high-wat records.

Height of Fishkill Creek during freshet of March 1, 1902.

7.45 a. m	13.6
11 a. m	14.5
4.45 p. m	12.4

The following table of discharge has been calculated from high-water marks observed for a number of years at the Groveville dam. The dam is of masonry, plank faced, has a straight horizontal crest 4 feet wide and 134 feet long. The discharge has been calculated by means of coefficients for the weir formula derived from Cornell experiment No. 11:

Flood discharge of Fishkill Creek above Groveville dam.

Date.	Year.	Depth on plank crest.	Discharge.	Run-off per square mile.
		Feet.	*Second-feet.*	*Second-feet.*
September 24	1882	6.33	7,700	38.5
March 22	1888	5.0	5,200	26.0
December 18	1888	4.5	4,400	22.0
January 12	1891	6.33	7,700	38.5
January 13	1891	4.0	3,650	18.25
January 22	1891	4.0	3,650	18.25
January 23	1891	6.92	8,800	44.00
March 10	1893	5.0	5,200	26.0
March 11	1893	4.25	4,000	20.0
March 12	1893	5.5	6,100	30.5
March 13	1893	5.0	5,200	26.0
March 14	1893	4.0	3,650	18.25
February 7	1896	6.67	8,300	41.5
March 1	1896	4.5	4,400	22.0
March 20	1896	6.67	8,300	41.5
March 1	1902	9.5	13,700	68.5

The drainage area above the Groveville dam is 200 square miles. The intensity of the freshet of March 1, 1902, on lower Fishkill Creek was probably increased by the formation and later tearing away of an ice blockade on the flood plain opposite Fishkill village.

A measurement of the low-water flow of Clove Creek, the largest tributary of Fishkill Creek, entering near Fishkill village, was made near the mouth of the stream September 24, 1902. The discharge was 3.5 second-feet from a drainage area of 20 square miles, or 0.18 second-foot per square mile.

TENMILE RIVER NEAR DOVER PLAINS, N. Y.

The gaging station is located at Tabor's bridge, 2 miles below Dover Plains village. It was established September 16, 1901, and is described in Water-Supply Paper No. 65, pages 85 to 87, where the results of discharge measurements and daily gage heights for 1901 are given. The stream is tributary to Housatonic River near Gaylordsville, Conn.

The following table gives a list of the discharge measurements made on the Tenmile River at Dover Plains, N. Y., during 1902:

Discharge measurements of Tenmile River at Dover Plains, N. Y.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
September 2	H. K. Barrows	3.95	63.0
August 19	do	4.28	100.0
June 10	W. W. Schlecht	4.45	158.0
February 13	do	4.67	[a] 179.0
August 4	H. K. Barrows	4.69	184.8
November 28	F. H. Tillinghast	4.80	211.0
November 14	do	4.87	211.0
May 15	W. W. Schlecht	4.88	230.0
June 30	do	4.92	249.0
May 28	do	5.50	380.0
October 2	P. M. Churchill	5.80	443.0
April 15	W. W. Schlecht	6.13	526.0
April 7	do	6.18	558.0
May 2	do	6.46	640.0
July 21	H. K. Barrows	7.18	821.0
December 19	F. H. Tillinghast	8.28	1,330.0
March 3	W. W. Schlecht	10.41	2,386.0

[a] River nearly covered with ice from bank to bank and 1½ to 2½ inches thick.

Mean daily gage height, in feet, of Tenmile River at Dover Plains, N. Y.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	7.70	5.40	14.15	6.60	6.95	4.55	4.45	5.10	3.90	5.78	5.75	4.45
2	7.00	6.10	14.10	6.45	6.95	4.50	4.25	4.88	3.83	5.85	5.50	4.48
3	6.95	6.95	[a] 11.43	6.25	6.50	4.40	4.35	4.65	3.80	5.43	5.43	4.8
4	6.10	6.08	8.35	5.98	6.20	4.55	5.53	4.63	5.90	5.10	5.33	4.90
5	6.08	5.50	6.95	5.80	6.05	4.48	4.38	4.53	3.83	5.30	5.30	4.73
6	6.15	5.35	5.90	5.90	5.90	4.35	4.60	4.43	3.80	5.85	5.25	4.78
7	6.10	5.10	6.25	6.13	5.75	4.25	4.63	4.65	3.85	5.38	5.10	4.8
8	5.80	5.10	6.25	6.40	5.55	4.48	4.33	4.60	3.88	5.13	5.08	4.85
9	5.65	4.95	8.90	6.80	5.35	4.55	4.38	4.45	3.95	4.90	5.0	5.13
0	5.55	4.90	10.60	7.60	5.23	4.48	4.23	4.43	4.23	4.83	4.93	5.08
1	5.60	5.10	9.15	7.10	4.95	4.30	4.20	5.68	3.95	5.00	4.83	4.85
2	5.55	5.10	8.70	6.60	4.85	4.20	4.10	5.03	3.90	6.10	4.78	4.8
3	5.38	4.80	9.10	6.30	4.85	4.75	4.15	4.95	4.10	6.83	4.83	4.8
4	5.25	6.75	8.40	6.15	4.80	4.70	3.90	4.78	4.23	5.87	4.8	4.93
5	5.25	5.25	7.70	6.10	4.80	4.35	3.88	4.68	4.13	5.63	4.83	5.08
6	4.93	5.15	7.30	5.90	4.75	4.45	4.30	4.23	4.03	5.43	4.73	6.15
7	4.65	5.05	8.15	5.88	4.65	4.65	4.18	4.18	3.88	5.25	4.65	10.47
8	5.05	5.05	7.60	5.68	4.60	4.45	3.88	4.15	3.88	5.15	.....	9.13
9	5.10	5.00	6.55	5.58	4.65	4.28	4.03	4.15	4.03	5.27	4.6	8.28
0	5.05	4.85	6.13	5.45	4.68	4.15	4.65	4.18	4.28	5.20	4.53	7.7
1	5.05	4.75	6.10	5.35	4.58	4.40	6.98	4.25	4.33	4.90	4.55	7.74
2	11.95	4.68	6.15	5.23	4.50	4.60	7.15	4.23	4.13	4.80	4.58	11.5
3	8.10	4.40	6.20	5.13	4.40	4.38	6.35	4.10	4.15	4.75	4.55	10.65
4	6.35	4.50	6.25	5.03	4.30	4.33	5.75	4.08	4.08	4.73	4.53	8.58
5	5.80	4.65	6.05	4.95	4.30	4.15	5.68	4.08	4.05	4.65	4.58	7.95
6	5.70	5.83	5.90	4.95	5.05	4.10	5.50	3.98	4.08	4.55	4.7	7.48
7	7.80	8.45	5.85	5.30	5.30	4.05	5.30	3.93	4.65	4.60	4.93	7.05
8	7.45	9.73	7.43	5.25	5.50	4.05	5.40	3.85	6.50	7.05	4.78	6.63
9	6.55	.....	7.60	5.30	5.18	4.10	5.25	3.83	7.75	7.10	4.65	6.50
0	6.25	.....	7.30	7.00	4.80	4.70	5.65	3.80	5.98	6.37	4.53	6.55
1	5.50	.....	6.90	.....	4.70	.....	5.25	3.85	.....	6.00	.....	6.55

[a] Readings on new gage. From this date datum 0.33 above former gage-zero.

HOUSATONIC RIVER AT GAYLORDSVILLE, CONN.

This gaging station was established October 24, 1900, and is situated on the Housatonic about 2 miles below the point of inflow of Tenmile River. Discharge measurements are made from a cableway of 200 feet span placed across the stream 1¼ miles below the gage. The station is described and the results of gagings for preceding years are given in Water-Supply Paper No. 65, pages 87 to 90.

The following is a list of the discharge measurements made on the Housatonic River at Gaylordsville, Conn., during 1902.

Discharge measurements of Housatonic River at Gaylordsville, Conn.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
September 8	H. K. Barrows	3.45	543
September 19	Barrow & Churchill	3.75	640
August 20	H. K. Barrows	3.95	835
August 5	do	4.28	983
July 11	do	4.30	1,159
November 29	F. H. Tillinghast	4.40	1,282
June 23	W. W. Schlecht	4.46	1,177
November 15	F. H. Tillinghast	4.50	1,356
October 3	P. M. Churchill	5.35	2,133
May 3	W. W. Schlecht	6.10	4,459
December 20	F. H. Tillinghast	6.65	5,465
July 22	H. K. Barrows	6.68	5,119
March 18	W. W. Schlecht	7.63	8,259
March 4	do	9.9	13,601

Mean daily gage height, in feet, of Housatonic River at Gaylordsville, Conn.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	7.10	4.90	14.30	6.80	6.80	4.70	4.80	4.80	3.80	5.50	5.50	4.1
2	6.50	4.90	10.80	6.60	6.30	4.40	4.60	4.65	3.55	5.50	5.30	4.1
3	5.90	5.40	9.90	6.80	6.10	4.40	4.40	4.65	3.50	5.25	5.00	4.4
4	5.30	4.90	10.20	5.80	5.90	4.60	4.70	4.45	3.60	5.15	4.95	4.6
5	5.20	4.80	7.80	5.80	5.60	4.90	4.50	4.30	3.65	5.00	4.85	4.6
6	5.30	4.60	6.80	5.50	5.50	4.80	4.50	4.40	3.55	5.15	4.75	4.3
7	5.30	4.50	6.50	5.50	5.50	4.60	4.80	4.60	3.65	5.00	4.65	4.3
8	5.20	4.40	6.80	5.70	5.30	4.60	5.00	4.55	3.50	4.85	4.60	4.3
9	5.30	8.50	6.80	6.10	5.20	4.40	4.70	4.55	3.55	4.70	4.5	3.4
10	5.10	6.80	7.50	6.80	4.90	4.60	4.50	4.45	4.00	4.55	4.35	3.5
11	5.00	7.00	7.20	6.90	5.00	4.50	4.40	4.50	4.00	4.40	4.3	3.7
12	4.90	8.00	7.70	6.80	4.90	4.50	4.30	5.15	3.90	5.30	4.45	3.7
13	4.70	8.80	7.80	6.80	4.90	4.40	4.20	5.00	3.85	5.30	4.4	4.0
14	4.30	8.30	8.00	6.70	4.80	4.70	4.00	4.70	4.10	5.10	4.5	4.0
15	4.50	8.00	7.90	6.20	4.70	4.60	3.90	4.50	4.00	5.00	4.5	4.2
16	4.50	7.10	7.70	5.90	4.60	4.30	4.10	4.35	3.60	4.80	4.4	4.9
17	4.30	6.80	7.90	5.80	4.60	4.50	4.20	4.20	3.70	4.75	4.35	7.9
18	4.20	7.00	7.60	5.60	4.50	4.40	3.90	4.00	3.75	4.60	4.25	7.5
19	4.40	7.50	7.30	5.60	4.40	4.40	3.80	3.80	3.80	4.55	4.3	6.7
20	4.20	7.30	7.00	5.50	4.30	4.40	4.65	4.05	3.85	4.25	4.25	6.5
21	4.50	7.20	6.60	5.20	4.60	4.30	6.00	3.95	4.05	4.30	4.3	6.0
22	8.50	7.20	6.60	5.20	4.40	4.70	6.00	4.05	3.75	4.45	4.2	8.0
23	6.80	6.80	6.10	5.10	4.30	4.50	6.00	4.10	3.60	4.40	4.2	8.
24	6.30	6.50	5.90	5.10	4.10	4.30	5.70	4.10	3.70	4.45	4.05	7.5
25	5.80	6.80	6.00	5.00	4.20	4.30	5.50	3.95	3.65	4.45	4.15	7.
26	5.60	7.00	6.00	4.90	4.50	4.30	5.30	3.95	3.85	4.40	4.25	6.
27	5.90	10.60	5.90	5.00	4.60	4.20	4.95	3.95	4.20	4.30	4.6	6.5
28	5.70	9.00	5.90	5.10	5.30	4.20	4.85	3.95	4.60	5.85	4.5	6.
29	5.30	.....	6.70	5.10	5.30	4.10	5.55	3.90	6.30	6.55	4.4	5.5
30	4.90	.....	6.70	6.20	5.00	4.30	5.45	3.90	6.00	6.00	4.25	5.
31	4.90	.....	6.70	.....	4.70	.....	5.40	3.70	.....	5.80	.....	5.

PASSAIC RIVER DRAINAGE BASIN.

Passaic River has its rise in Somerset and Morris counties, N. J. Above its confluence with Pompton River, its main tributary, it meanders through a flat country of Triassic red sandstones, to which in large measure must be attributed the turbidity of its waters. In contrast with the sluggish, muddy character of the Passaic, the Pompton is a rapid stream and its waters are clear. It drains parts of Sussex, Passaic, and Morris counties, and traverses for a large part of its course a country of hard crystalline rocks and heavy forests, the general level of which is several hundred feet above that of the Passaic. At their confluence the Pompton enters with a current which carries it well toward the right bank of the Passaic, and at times of flood causes much backwater in the latter.

The flow of Passaic River is of special interest from the fact that several large cities in its drainage basin take their public water supply from it, and because of the valuable water-power privileges along its course, particularly at the city of Paterson. Several cities, including Paterson and Passaic, throw their sewage into this stream, and in the lower part of its course it becomes so polluted as to be offensive to property holders along its banks and to seriously interfere with the comfort and pleasure of the inhabitants of several towns.

Measurements of the flow over the dam at Paterson have been made for several years, but the data are not available for publication.

The United States Geological Survey has a gaging station on the Passaic River at Two Bridges, New Jersey, and also on the Pompton River at the same place. These stations are under the supervision of George B. Hollister.

The highest recorded flood occurring on these watersheds is that of February and March, 1902, the estimated discharge at Dundee dam being 24,800 second-feet. The next highest occurred on September 22 to 30, 1882, when the estimated discharge was 18,265 second-feet. These floods will be fully described in a forthcoming paper.

POMPTON RIVER AT TWO BRIDGES, NEW JERSEY.

A station was established May 2, 1901, by George B. Hollister, on Pompton River just above its junction with Passaic River, a point 2 miles south of the railway station at Mountain View, N. J., and 2½ miles west of Littlefalls, N. J. Measurements are made from a wagon bridge. The gage is a vertical pine board, marked in feet and tenths, spiked to the middle masonry pier on the downstream side. The bench mark is the top of the capstone of the same pier, and its elevation is 10.7 feet above the datum of the gage. The channel, which is gravelly, is straight for some distance above and below the bridge, the banks on both sides being about 8 feet high and subject to overflow at times of freshets only.

The flood of February–March, 1902, is considered the highest that has been recorded.

The following discharge measurements were made during 1902 by George B. Hollister:

January 17: Gage height, 1.55 feet; discharge, 475 second-feet.
March 1: Gage height, 11.70 feet; discharge, 8,023 second-feet.
May 30: Gage height, 2.10 feet; discharge, 556 second-feet.
June 18: Gage height, 1.30 feet; discharge, 189 second-feet.
September 11: Gage height, 1.50 feet; discharge, 170 second-feet.

Daily gage height, in feet, of Pompton River at Two Bridges, New Jersey.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	8.35	3.00	10.40	4.35	3.30	2.15	2.50	2.75	1.30	4.55	2.75	1.20
2	7.55	3.50	14.40	4.15	3.05	1.75	2.25	2.65	1.20	4.95	2.70	1.45
3	6.45	3.70	14.00	3.40	2.80	1.30	2.00	2.55	1.10	4.70	2.70	1.70
4	6.25	3.50	10.80	3.25	2.95	1.30	2.10	2.30	1.10	4.45	2.65	2.00
5	5.15	3.40	9.75	3.15	2.55	1.20	2.00	2.10	1.10	4.45	2.55	2.00
6	4.00	3.30	8.40	3.00	2.40	1.20	1.85	2.00	1.10	4.75	2.35	2.10
7	3.30	2.60	7.15	3.15	2.15	1.10	1.65	1.85	1.00	4.50	2.25	2.10
8	2.95	2.10	6.15	3.65	2.00	1.10	1.45	1.70	1.10	4.25	2.20	2.20
9	2.55	1.90	6.55	5.30	2.00	1.10	1.40	1.60	1.10	3.95	2.05	2.35
10	2.35	1.70	7.35	6.60	1.85	1.00	1.40	1.50	1.20	3.60	1.90	2.25
11	2.25	1.50	7.70	6.60	1.50	1.00	1.35	2.55	1.25	3.30	1.80	2.10
12	2.35	1.50	7.45	6.15	1.30	1.00	1.30	2.95	1.30	4.60	1.55	2.10
13	2.30	1.40	7.30	5.80	1.30	1.05	1.20	3.60	1.40	5.05	1.45	2.00
14	2.20	1.40	7.50	4.55	1.30	1.25	1.20	3.50	1.50	4.85	1.35	1.90
15	2.05	1.30	7.15	4.05	1.20	1.30	1.20	3.50	1.50	4.65	1.30	1.85
16	1.50	1.20	7.00	3.60	1.20	1.30	1.20	3.25	1.40	4.15	1.30	2.30
17	1.60	1.20	5.90	3.40	1.20	1.30	1.10	3.05	1.15	3.65	1.30	5.65
18	1.50	1.20	6.60	3.10	1.15	1.30	1.20	2.70	1.10	3.00	1.20	8.25
19	1.45	1.10	5.55	2.60	1.10	1.25	1.30	2.55	1.10	3.00	1.20	8.20
20	1.30	1.20	4.65	2.50	1.20	1.25	1.30	2.65	1.10	2.95	1.20	8.00
21	1.30	1.30	4.35	2.50	1.20	1.35	1.35	2.45	1.10	2.80	1.20	8.00
22	5.75	1.50	4.10	2.40	1.20	1.70	1.50	2.25	1.10	2.65	1.10	7.55
23	7.75	1.70	3.75	2.40	1.10	1.65	1.45	2.15	1.00	2.40	1.00	7.90
24	6.85	1.85	3.40	2.30	1.10	1.50	1.40	1.90	1.10	2.05	1.00	9.55
25	5.45	2.45	3.15	2.20	1.20	1.50	1.75	1.60	1.25	1.85	1.20	9.25
26	4.35	4.30	2.85	1.80	1.75	1.50	2.15	1.45	2.70	1.75	1.30	8.30
27	4.30	7.20	2.60	1.65	2.15	1.65	2.20	1.20	3.30	1.65	1.45	8.05
28	4.05	8.60	2.45	1.60	2.75	1.55	2.20	1.35	3.95	2.40	1.50	7.20
29	3.45	.....	3.30	2.40	2.80	1.35	2.15	1.40	4.60	2.85	1.40	6.65
30	3.15	.....	4.55	3.00	2.45	2.45	2.70	1.30	4.55	3.00	1.30	6.65
31	3.20	.....	4.45	.....	2.25	.....	2.80	1.30	.....	3.90	.....	6.55

Estimated monthly discharge of Pompton River at Two Bridges, New Jersey.

[Drainage area, 360 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	5,415	300	2,080	5.76	6.66
February	5,598	221	1,180	3.28	3.42
March	[a] 11,600	1,109	[a] 4,050	[a] 11.25	[a] 12.97
April	4,138	505	1,867	5.19	5.79
May	1,729	221	703	1.95	2.25
June	1,109	195	376	1.04	1.16
July	1,400	221	583	1.62	1.87
August	1,948	255	969	2.69	3.10
September	2,678	195	569	1.58	1.76
October	3,006	540	1,927	5.35	6.17
November	1,327	195	575	1.60	1.79
December	6,291	255	2,795	7.76	8.95
The year	[a] 11,600	195	1,473	4.09	55.89

[a] Estimated.

PASSAIC RIVER AT TWO BRIDGES, NEW JERSEY.

This station was established May 2, 1901, by George B. Hollister, just above the confluence with Pompton River. Discharge measurements are made from a wagon bridge. The gage consists of a vertical pine board, marked in feet and tenths, spiked to the protecting timber on the upstream side of the first pier from the left bank. The bench mark is the top of the capstone of this pier, and its elevation is 13.65 feet above the datum of the gage. The channel is straight for some distance above and below the bridge. The bottom is gravelly. The right bank is about 10 feet high, while the left bank is lower and liable to overflow.

The flood of February–March, 1902, is considered the highest that has been recorded.

The following discharge measurements were made during 1902 by George B. Hollister:

January 17: Gage height, 2.30 feet; discharge, 398 second-feet.
March 1: Gage height, 13 feet; discharge, 8,096 second-feet.
May 20: Gage height, 3 feet; discharge, 622 second-feet.
June 18: Gage height, 2.30 feet; discharge, 328 second-feet.
September 11: Gage height, 2.30 feet; discharge, 354 second-feet.

Daily gage height, in feet, of Passaic River at Two Bridges, New Jersey.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	9.50	3.70	11.55	5.25	4.40	3.10	3.30	3.75	2.30	5.55	3.75	2.20
2	8.25	4.35	13.50	5.15	4.10	2.70	3.25	3.95	2.20	5.95	3.70	2.45
3	7.45	4.50	12.80	4.65	3.80	2.40	3.00	3.55	2.15	5.70	3.65	2.70
4	7.40	4.30	11.80	4.40	3.95	2.30	3.10	3.30	2.00	5.55	3.55	3.00
5	7.05	4.15	10.75	4.15	3.55	2.20	3.00	3.10	2.00	5.45	3.35	3.00
6	6.90	4.00	9.40	4.00	3.40	2.15	2.85	3.00	2.00	5.75	3.30	3.10
7	4.50	3.80	8.15	4.15	3.15	2.10	2.65	2.85	2.00	5.50	3.20	3.10
8	3.90	3.60	7.20	4.60	3.00	2.10	2.55	2.70	2.10	5.25	3.20	3.20
9	3.50	3.40	7.50	6.25	3.00	2.10	2.40	2.60	2.10	4.95	3.05	3.35
10	3.20	3.20	8.35	7.65	2.85	2.00	2.40	2.45	2.20	4.60	2.90	5.25
11	3.00	3.20	8.70	7.65	2.50	2.00	2.35	3.50	2.25	4.30	2.80	3.10
12	3.40	2.90	8.45	7.15	2.30	2.00	2.30	3.95	2.30	5.55	2.55	3.10
13	3.25	2.60	8.30	6.70	2.30	2.20	2.20	4.60	2.40	6.05	2.45	3.00
14	3.10	2.30	8.50	5.55	2.30	2.30	2.20	4.50	2.50	5.85	2.35	2.90
15	2.80	2.10	8.15	5.10	2.30	2.30	2.20	4.50	2.50	5.65	2.30	2.85
16	2.50	2.10	8.00	4.60	2.20	2.20	2.20	4.25	2.40	5.15	2.30	2.80
17	2.50	2.10	6.90	4.40	2.20	2.30	2.10	4.05	2.15	5.65	2.30	6.65
18	2.50	2.10	7.55	4.10	2.15	2.30	2.20	3.70	2.10	4.40	2.20	9.25
19	2.45	2.20	6.75	3.40	2.10	2.25	2.25	3.55	2.10	4.00	2.20	9.20
20	2.40	2.30	5.65	3.50	2.20	2.25	2.30	3.60	2.10	3.95	2.20	9.00
21	2.00	2.45	5.35	3.50	2.20	2.40	2.35	3.35	2.10	3.80	2.20	9.00
22	5.65	2.65	5.10	3.40	2.20	2.80	2.50	3.20	2.10	3.65	2.10	8.55
23	8.80	2.70	4.75	3.40	2.10	2.75	2.45	3.05	2.00	3.40	2.00	8.95
24	7.95	3.40	4.40	3.30	2.10	2.60	2.40	2.90	2.10	3.05	2.00	10.55
25	6.80	3.90	4.15	3.20	2.25	2.60	2.75	2.60	2.25	2.85	2.20	10.25
26	5.80	5.45	3.75	2.80	2.60	2.50	3.15	2.35	2.85	2.75	2.30	9.45
27	5.70	8.15	3.50	2.65	2.95	2.65	3.20	2.20	3.60	2.65	2.45	9.05
28	5.45	9.60	3.35	2.65	3.35	2.55	3.20	2.35	4.55	3.40	2.50	8.20
29	4.75	.....	4.25	3.30	3.65	2.40	3.15	2.40	5.60	3.60	2.40	7.65
30	4.40	.....	5.55	3.90	3.45	3.30	3.70	2.30	5.55	4.00	2.30	7.65
31	3.80	.....	5.35	.....	3.25	.....	3.85	2.30	.....	3.90	.....	7.55

Estimated monthly discharge of Passaic River at Two Bridges, New Jersey.

[Drainage area, 360 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	3,832	225	1,616	4.49	5.18
February	4,011	271	1,003	2.79	2.91
March	[a] 11,600	863	[a] 2,863	[a] 7.95	[a] 9.16
April	3,016	527	1,424	3.96	4.42
May	1,375	271	618	1.72	1.98
June	839	225	408	1.13	1.26
July	1,103	271	550	1.53	1.76
August	1,475	317	808	2.24	2.58
September	1,975	225	488	1.36	1.52
October	2,200	527	1,467	4.08	4.70
November	1,055	225	534	1.48	1.65
December	4,496	317	2,071	5.75	6.63
The year	[a] 11,600	225	1,154	3.21	43.75

[a] Estimated.

MISCELLANEOUS NEW JERSEY STREAMS.

The following discharge measurements were made on streams in New Jersey:

Miscellaneous discharge measurements made on New Jersey streams.

Date.	Stream.	Locality.	Discharge.
1902.			*Sec.-ft.*
July 1	Paulinskill	Warrington, N. J	1,390
August 31	do	Columbia, N. J	98
June 26	Ramapo	Mahwah, N. J	123
October 29	do	do	678
September 24	Rockaway	Old Boonton, N. J	33
August 23	do	do	146
September 11	do	do	164
September 23	do	do	102
October 30	do	do	488
October 30	Pompton	Pompton Plains, N. J	1,066
September 26	Passaic	Stanley, N. J	195
October 30	do	do	431
September 26	do	Millington, N. J	92
August 28	Whippany	Whippany, N. J	35
July 1	North Branch Raritan	Far Hills, N. J	35
August 29	do	do	41
September 26	do	Pluckemin, N. J	171
September 19	Raritan	Bound Brook, N. J	323
September 20	do	do	427
November 6	do	do	947
September 24	South Branch Raritan	German Valley, N. J	58
September 24	do	Califon, N. J	51
September 25	do	Neshanic, N. J	172
September	do	High Bridge, N. J	120
July 1	Lamington	Pottersville, N. J	545
August 29	do	do	32
September 23	Pequannock	Pompton, N. J	90
August 22	Wanaque	do	97

DELAWARE RIVER DRAINAGE BASIN.

Gaging stations are maintained in this basin by the United States Geological Survey on the West Branch of the Delaware at Hancock, N. Y.; on the East Branch of the Delaware at Hancock, N. Y.; on the Delaware River at Port Jervis, N. Y., and at Lambertville, N. J.; on the Neversink River at Port Jervis, N. J.; and on the Lehigh

River at South Bethlehem, Pa. Aside from these stations measurements have been made for several years by John E. Codman, hydrographer of the water department of the city of Philadelphia. The stations maintained by Mr. Codman are located on the following streams, all in the vicinity of Philadelphia: Perkiomen, Wissahickon, Tohickon, and Neshaminy creeks, and on the Schuylkill River. The following pages give the records of these stations for 1902.

WEST BRANCH OF DELAWARE RIVER AT HANCOCK, N. Y.

The Delaware River rises on the slope of Mine Mountain, near the southwestern line of Schoharie County, flows southwesterly across central Delaware County to Deposit, where it is joined by Oquaga Creek, a large tributary draining eastern Broome County. The upper drainage area is relatively long and narrow, with numerous short lateral tributaries. It is rugged and to a considerable extent wooded. There are low water-power dams near Hamden and Delhi. At Deposit the stream turns abruptly to the southeast, forming the boundary line between New York and Pennsylvania, until Port Jervis is reached. Here it encounters the foot of the Shawangunk Range, and its direction of flow is again turned to the southwest. Below Port Jervis the Delaware forms the division between Pennsylvania and New Jersey, and ultimately empties into Delaware Bay below Philadelphia. Above Hancock the main stream is known as the West Branch of Delaware River,[a] to distinguish it from the smaller East or Pepacton Branch of Delaware River.

The gaging station on West Branch of Delaware River is situated at the suspension bridge in Hancock village. A 15-foot weight and wire gage, reading decimally, is attached to the upstream side of the bridge. The stream bed is of rock, overlain with gravel and cobblestone.

The bench mark is a circular chisel draft on the upstream corner of the left abutment. Elevation of bench mark is 100 feet. Elevation of water surface when gage reads zero is 75.75. The gage was erected October 15, 1902, by P. M. Churchill and C. C. Covert.

The gage is read each day at 8 a. m. and again at 4 p. m. by David Pulver, collector of tolls at the bridge.

The gaging station is situated approximately one-half mile upstream from the junction of the East and West branches of the stream. The bridge has a span between abutments of 235 feet. The bridge is spaced in 5-foot intervals on the downstream side, beginning at face of left abutment. Discharge measurements are made from the lower side of the bridge.

A discharge measurement by P. M. Churchill and C. C. Covert hydrographers, October 15, 1902, showed a discharge of 1,123 second feet, gage height 3.95 feet.

[a] Sometimes called Mohawk. It should not be confused with the Mohawk River, a tributary of Hudson River.

Mean daily gage height, in feet, of West Branch of Delaware River at Hancock, N. Y.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1902.				1902.				1902.			
1	.....	4.55	3.00	12	.....	3.30	3.70	23	3.18	2.65	6.90
2	.....	4.33	2.98	13	.....	3.20	3.85	24	3.18	2.80	5.50
3	.....	4.33	3.25	14	.....	3.20	3.80	25	3.20	2.73	5.23
4	.....	4.43	3.30	15	3.90	3.07	3.90	26	3.00	2.90	4.72
5	.....	3.75	3.25	16	3.60	2.97	5.25	27	3.15	3.15	4.55
6	.....	3.75	3.25	17	3.40	2.87	7.47	28	7.03	3.13	4.35
7	.....	3.53	3.25	18	3.40	2.87	6.23	29	6.83	3.05	4.05
8	.....	3.35	3.28	19	3.47	2.85	5.40	30	5.57	2.93	4.25
9	.....	3.32	3.03	20	3.50	2.80	5.18	31	5.00	.....	4.00
10	.....	3.25	3.20	21	3.43	2.82	4.93				
11	.....	3.15	3.75	22	3.35	2.85	8.43				

EAST BRANCH OF DELAWARE RIVER AT HANCOCK, N. Y.

East Branch of Delaware River flows parallel to the West Branch across southern Delaware County. The drainage area is broader and the tributaries longer and more branching than those of the West Branch. Many of the tributaries head in small lakes and ponds.

The gaging station is situated at the highway bridge in Hancock village. A 15-foot weight and wire gage, graduated decimally, is attached to the horizontal chords of the upstream side of the second span from the left or south abutment. The reference point is a circular chisel draft on the downstream corner of the left abutment. Its elevation referred to the bench mark described above in connection with the station on the West Branch of the stream is 98.52.

The elevation of the datum plane of the gage or of water surface when the gage reads zero is 70.59, or 5.16 feet lower than that for the West Branch station.

The bridge consists of five spans and has a length between abutments of 425.5 feet. Discharge measurements are usually made from the downstream side. Bridge is marked off in 5-foot spaces, beginning at right abutment.

During low water the elevation of water in the East Branch is lower than that in the West Branch at the respective gaging stations. There is considerable fall in each branch from the gaging station to the mouth of the stream.

The gage was erected October 14, 1902, by P. M. Churchill and C. C. Covert. The gage is read twice daily, at 8 a. m. and 4 p. m., by D. B. Van Etten. A discharge measurement made by Messrs. Churchill and Covert October 14, 1902, with a gage height of 4.345 feet, showed a discharge of 2,320 second-feet.

The drainage area tributary to each branch between the gaging station and the mouth of the stream is approximately 1 square mile.

The location of the two gaging stations close to the mouths of the

branches enables the total discharge of the main stream at the confluence of its principal branches to be determined.

The highest recent freshet on the East Branch occurred December 15–16, 1901. The elevation of water surface was 93.02 feet, equivalent to a gage reading of 22.43 feet.

Mean daily gage height, in feet, of East Branch of Delaware River at Hancock, N. Y.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1902.				1902.				1902.			
1		4.85	3.40	12		3.60	5.55	23	3.60	3.20	7.45
2		4.55	3.40	13		3.60	5.60	24	3.50	3.30	5.75
3		4.40	3.50	14		3.50	5.85	25	3.50	3.20	5.40
4		4.25	3.70	15	4.20	3.40	5.95	26	3.40	3.25	5.00
5		4.10	3.70	16	4.10	3.40	6.50	27	3.40	3.45	4.75
6		4.00	3.50	17	4.00	3.40	8.65	28	6.95	3.60	4.45
7		3.95	3.50	18	3.90	3.30	6.35	29	7.05	3.55	4.15
8		3.80	3.70	19	3.80	3.30	5.50	30	5.75	3.50	4.35
9		3.70	5.75	20	3.80	3.30	5.00	31	5.40		4.10
10		3.60	5.60	21	3.75	3.20	4.80				
11		3.60	5.90	22	3.60	3.20	10.00				

DELAWARE RIVER AT PORT JERVIS, N. Y.

From Hancock to Port Jervis, a distance by river of 76 miles, the Delaware flows in a broad, shallow channel, with numerous slight rifts and a relatively rapid current. Several large tributaries enter in this section of the stream, notably Mongaup and Callicoon creeks and Neversink River from the New York side, and the Lackawaxen River from Pennsylvania.[a]

The following table shows the drainage areas of the Upper Delaware River and its principal tributaries:

Drainage area of Upper Delaware River and principal tributaries.

	Square miles.
Delaware River at mouth	10,000
Delaware River at Lambertville, N. J.[b]	6,820
Delaware River at Port Jervis, below mouth of Neversink River	3,600
Delaware River at Port Jervis, above mouth of Neversink River	3,254
Neversink River at mouth	346
Lackawaxen River at mouth	597
Mongaup Creek at mouth	231
Delaware River below junction of branches at Hancock, N. Y	1,604
West Branch of Delaware River above mouth at Hancock, N. Y	685
West Branch of Delaware River above Oquaga Creek at Deposit, N. Y	519
West Branch of Delaware River at Walton, N. Y	348
East Branch of Delaware River at mouth, Hancock, N. Y	919

[a] For general description and drainage areas of Delaware River see Tenth United States Census, Volume XVI, pp. 607–638.

[b] Results are given in Water Supply and Irrigation Paper United States Geological Survey No. 65, p. 214.

The drainage area of Delaware River above Port Jervis lies about four-fifths in New York and one-fifth in Pennsylvania.

Arrangements have been made for the establishment of a gaging station at the upper railroad bridge in Port Jervis. The bridge is situated about 1 mile upstream from the mouth of Neversink River. The bridge consists of two spans and stands squarely across the stream. The current is smooth and uniform. The stream bed is cobblestone and gravel, and fairly permanent.

The following discharge measurements have been made by George B. Hollister, resident hydrographer for New Jersey, at the Barrett suspension toll bridge:

June 28: Gage height, 29.3 feet; discharge, 4,629 second-feet.
September 2: Gage height, 30.6 feet; discharge, 1,501 second-feet.

The gage height as given is the distance down to water surface from a reference point on top of upstream guard rail 470 feet from the left-hand abutment.

NEVERSINK RIVER AT PORT JERVIS, N. Y.

Neversink River rises in southwestern Ulster County. Two branches unite to form the main stream near Sullivan County line. The stream then flows southerly, crossing eastern Sullivan County, and enters Delaware River at Port Jervis.

The drainage basin contains numerous small lakes. The fall is rapid and often precipitous. This stream has been suggested as a possible source of water supply for New York, the proposed point of diversion being "The Kitchen," at Quarryville, at an elevation of 850 feet above tide. The drainage area at this point is 200 square miles and at the mouth of the stream 346 square miles.[a]

The gaging station is situated at the East Main street highway bridge in Port Jervis.[b] A wire-and-weight gage is secured to the iron-work of the bridge on the downstream side. The bench mark is an anchor bolt in top of cemetery wall on right bank of stream; its elevation is taken at 100 feet. The datum plane of the gage referred to this bench mark is 72.24. The station was established October 16, 1902, by P. M. Churchill and C. C. Covert. The gage record is kept by Edwin J. Earley. Readings are taken at 8.30 a. m. and 5 p. m. each day.

The bridge has a single span of 130 feet between abutments. The stream flows between entraining walls and has a rock bed overlain in part by earth. The discharge measurements are usually made from the upstream side of the bridge, which has been divided into 5-foot stations, beginning at the right-hand abutment.

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[a] See Freeman's report on New York water supply, 1900, p. 491.
[b] Temporary.

Discharge measurements of Neversink River at Port Jervis, N. Y.

Date.	Gage height.	Discharge.	Hydrographer.
1902.	*Feet.*	*Second-feet.*	
October 16	7.45	945	Churchill and Covert.
November 10	7.00	524	F. H. Tillinghast.

Two discharge measurements were made before the gage was placed by George B. Hollister:

	Second-feet.
June 28, 1902	374
September 17, 1902	15

Mean daily gage height, in feet, of Neversink River at Port Jervis, N. Y.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1902.				1902.				1902.			
1	.....	7.60	6.90	12	.....	7.00	6.90	23	7.05	6.80	13.45
2	.....	7.40	6.90	13	.....	7.00	6.90	24	7.03	6.80	10.45
3	.....	7.25	7.10	14	.....	6.90	6.90	25	7.00	6.80	8.55
4	.....	7.20	7.20	15	.....	6.90	6.85	26	6.95	6.80	8.15
5	.....	7.20	7.00	16	7.50	6.90	6.95	27	6.90	6.90	7.85
6	.....	7.15	7.00	17	7.40	6.90	11.75	28	8.75	7.00	7.60
7	.....	7.15	7.00	18	7.30	6.90	9.11	29	10.05	7.00	7.50
8	.....	7.10	6.90	19	7.30	6.80	9.50	30	8.85	6.90	7.40
9	.....	7.00	6.70	20	7.20	.....	9.05	31	7.95	.....	7.35
10	.....	7.00	6.70	21	7.10	.....	8.45				
11	.....	7.00	6.90	22	7.08	.....	13.10				

LEHIGH RIVER AT SOUTH BETHLEHEM, PA.

This station was established December 22, 1902, on the New street bridge, and is under the general supervision of Prof. Mansfield Merriman, C. E., of Lehigh University. The equipment consists of a standard chain-and-weight gage, which is referred to a horizontal scale board graduated to feet and tenths, inclosed in a lock box attached to the lower side of the bridge. The length of the chain from the zero to the extreme end of the weight is 43.77 feet. The datum of the gage is 210.55 feet above sea level, and is referred to the Lehigh Valley Railroad bench mark No. 72, which is an iron pin in the south pier of the New street bridge. Its elevation is 232.87 feet above sea level.

The following discharge measurements were made during 1902:

September 22: Gage height, 2.3 feet; discharge, 1,171 second-feet.
November 14: Gage height, 2.8 feet; discharge, 1,696 second-feet.
November 20: Gage height, 2.6 feet; discharge, 1,436 second-feet.

Daily gage height, in feet, of Lehigh River at New street bridge, South Bethlehem, Pa.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1902.					1902.					1902.				
1	.....	6.10	3.75	2.60	12	.....	5.67	2.85	2.70	23	2.20	3.20	2.60	8.35
2	.....	6.10	3.65	2.60	13	.....	5.85	2.80	2.75	24	2.17	3.05	2.60	6.45
3	.....	5.30	3.50	2.90	14	.....	5.65	2.80	2.80	25	2.80	3.80	2.60	5.65
4	.....	4.75	3.40	3.00	15	.....	4.55	2.80	2.80	26	8.45	3.00	2.60	5.10
5	.....	4.65	3.30	3.00	16	.....	4.25	2.70	4.40	27	8.10	2.95	2.60	4.70
6	.....	5.55	3.40	3.00	17	.....	3.95	2.75	8.70	28	6.20	5.25	2.60	4.30
7	.....	5.05	3.35	3.00	18	.....	3.80	2.65	6.00	29	5.85	4.90	2.60	4.10
8	.....	4.60	3.20	3.00	19	.....	3.75	2.65	5.10	30	5.70	4.40	2.60	4.00
9	.....	4.40	3.05	2.55	20	.....	3.65	2.60	4.60	31	.....	4.00	.....	3.90
10	.....	4.00	2.95	2.55	21	.....	3.40	2.60	4.90					
11	.....	3.75	2.90	2.60	22	2.30	3.25	2.60	12.30					

DELAWARE RIVER AT LAMBERTVILLE, N. J.

This river rises in Delaware County, N. Y., flows in a southerly direction, forming the boundary between the States of Pennsylvania and New Jersey, and empties into Delaware Bay. Measurements of flow were made during the latter half of June, 1891, by Prof. Dwight Porter and students at the Delaware Watergap, Pa. The results show a flow of from 2,000 to 2,200 second-feet. This was said to be the lowest June stage for five years. Measurements were made during the drought of 1895 by Prof L. M. Haupt at Point Pleasant, Pa., near the intake of the Delaware and Raritan Canal feeder. The discharge above the bridge was 1,657 second-feet and below the bridge 1,328 second-feet. Delaware River was measured by E. G. Paul, June 4, 1899, at Martins Creek, Pa., 7 miles above the mouth of Lehigh River, and a discharge of 2,724 second-feet was found. Systematic measurements of river height were begun on July 23, 1897, at the covered toll bridge at Lambertville, N. J., a town on the Belvidere division of the Pennsylvania Railroad, 16 miles above Trenton. The gage, established by E. G. Paul, consists of a stamped-link brass chain with a 6-pound sash weight attached. The chain passes over a pulley and the index is referred to a scale painted on a horizontal board 32 feet long, fastened to the studding and inclosed in a wooden cover. The zero of the gage chain is marked by a copper rivet, which is 28.85 feet from the end of the weight, and reads 2 feet when the water is at zero on a gage on the first bridge pier. Measurements are made from the windows of this covered bridge. The initial point for soundings is on the left bank. The channel above and below is nearly straight, the water being sluggish for a short space on the left side. The right bank is high and and the bed of the stream is of gravel and sand. The observer is Charles H. Naylor, collector of bridge tolls, Lambertville, N. J.

The following discharge measurements were made during 1902 by E. G. Paul:

April 15: Gage height, 6.3 feet; discharge, including canal, 30,549 second-feet; discharge of canal, 513 second-feet.

September 23: Gage height, 2.9 feet; discharge measurement, including canal, 3,985 second-feet; discharge of canal, 517 second-feet.

Daily gage height, in feet, of Delaware River at Lambertville, N. J.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	7.40	(a)	18.17	7.05	5.80	3.70	6.10	5.45	3.30	10.55	6.15	4.10
2	6.45	4.75	20.21	6.60	5.85	3.55	6.05	5.20	3.20	9.60	5.75	4.00
3	5.80	4.90	16.40	6.25	5.40	3.45	5.50	5.95	3.10	8.60	5.40	4.60
4	5.40	(a)	12.50	5.95	5.20	3.40	5.15	5.70	2.95	7.40	5.10	4.65
5	5.00	.....	9.45	5.65	5.15	3.30	5.75	5.15	2.90	6.90	5.00	4.55
6	4.95	.....	8.15	5.45	5.00	3.30	5.20	4.85	2.85	7.10	4.85	4.50
7	4.90	.....	6.80	5.60	4.70	3.55	5.00	4.70	2.70	6.65	4.75	4.40
8	4.85	.....	6.45	6.05	4.65	3.55	5.10	4.50	2.80	6.25	4.65	4.20
9	4.70	.....	7.00	7.20	4.50	3.40	5.10	4.35	2.90	5.80	4.55	4.15
10	4.70	.....	7.70	8.05	4.30	3.35	4.70	4.20	3.45	5.45	4.40	4.10
11	4.50	.....	7.95	8.30	4.20	3.30	4.50	4.15	3.65	5.20	4.30	4.10
12	4.45	.....	7.60	7.55	4.10	3.40	4.25	4.20	4.10	6.70	4.20	4.10
13	4.15	.....	8.85	7.10	4.10	3.45	4.15	4.10	3.95	7.15	4.10	4.20
14	(a)	.....	11.05	6.75	4.00	3.65	4.00	3.90	3.70	6.90	4.10	4.10
15	.....	.....	10.20	6.25	3.90	3.65	3.80	3.80	3.55	6.30	4.00	4.10
16	.....	.....	8.70	5.95	3.90	3.55	3.65	3.70	3.45	5.90	3.95	5.60
17	.....	.....	9.35	5.60	3.80	3.55	3.60	3.60	3.25	5.55	4.00	8.75
18	.....	.....	11.80	5.45	3.75	3.75	3.50	3.50	3.20	5.25	3.85	9.60
19	.....	.....	9.70	5.15	3.75	3.85	3.50	3.30	3.00	5.10	3.80	8.25
20	3.90	.....	7.90	5.10	3.65	3.80	3.65	3.45	2.95	4.95	3.80	7.30
21	3.80	.....	7.20	4.90	3.70	3.75	3.95	3.30	2.95	4.75	3.70	7.60
22	8.93	.....	6.75	4.80	3.65	4.85	6.10	3.50	3.10	4.60	3.70	11.80
23	8.55	.....	6.35	4.65	3.60	4.30	6.35	3.35	3.00	4.50	3.70	12.90
24	7.95	.....	6.20	4.55	3.55	4.15	5.75	3.40	2.85	4.40	3.70	10.70
25	6.60	.....	6.10	4.45	3.50	3.85	5.55	3.30	2.90	4.30	3.70	8.60
26	5.80	8.90	5.90	4.30	3.50	3.85	5.90	3.20	5.65	4.25	3.85	7.60
27	5.70	8.66	5.70	4.30	3.95	4.00	5.45	3.00	9.70	4.20	4.10	7.10
28	5.75	12.34	5.45	4.30	4.05	3.95	4.90	2.95	9.05	4.90	4.10	6.35
29	5.45	.....	5.80	4.20	4.10	4.00	4.80	3.15	8.35	7.20	4.20	5.85
30	(a)	.....	7.60	5.15	3.90	4.70	5.20	3.10	12.10	8.20	4.15	5.70
31	.....	.....	7.90	.....	3.85	.....	5.60	3.30	.....	6.95	.....	5.45

[a] Frozen January 14 to 19, January 30 to February 1, and February 4 to 25.

Rating table for Delaware River at Lambertville, N. J., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.4	1,750	4.0	8,550	5.6	22,150	7.2	37,810
2.6	2,100	4.2	10,000	5.8	24,050	7.4	39,870
2.8	2,600	4.4	11,650	6.0	25,950	7.6	41,930
3.0	3,300	4.6	13,350	6.2	27,850	7.8	43,990
3.2	4,100	4.8	15,050	6.4	29,750	8.0	46,050
3.4	5,050	5.0	16,750	6.6	31,700	8.5	51,200
3.6	6,100	5.2	18,500	6.8	33,710	9.0	56,350
3.8	7,250	5.4	20,300	7.0	35,750	9.5	61,500

Estimated monthly discharge of Delaware River at Lambertville, N. J.

[Drainage area, 6,855 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January [a]	----------	----------	[b] 20,017	[b] 2.92	[b] 3.37
February [a]	----------	----------	----------	----------	----------
March	171,813	20,750	55,811	8.14	9.38
April	49,140	10,000	24,039	3.51	3.92
May	24,525	5,550	10,701	1.56	1.80
June	14,200	4,550	6,848	1.00	1.12
July	26,900	5,550	16,352	2.39	2.76
August	25,475	3,125	9,310	1.36	1.41
September	88,280	2,300	12,922	1.89	2.11
October	72,315	10,000	28,250	4.12	4.75
November	27,375	6,650	11,323	1.65	1.84
December	96,520	8,550	29,351	4.28	4.93

[a] Frozen January 14 to 19, January 30 to February 1, and February 4 to 25. [b] Estimated.

PERKIOMEN CREEK AT FREDERICK, PA.

Perkiomen Creek drains an area lying northwest of the city of Philadelphia. It flows in a southerly direction, emptying into Schuylkill River about 7 miles above Norristown and about 18 miles above Philadelphia. The point of measurement of discharge is located at Frederick, this being about 12 miles above the mouth. This point is also above two large tributaries known as West Swamp Creek and

Northeast Branch of Perkiomen. Both of these tributaries have been measured—the first at Zieglerville, and the second near Schwenkville. The drainage area of the Perkiomen above the point of measurement is given by Rudolph Hering as 152 square miles, of which 111 are cultivated and improved and 41 untillable and wooded. Measurements of this creek were begun on August 20, 1884. Water-Supply Paper No. 35 contains tables of the daily discharge for the entire period from 1884 to 1899, inclusive. The records of daily discharge for 1902, as furnished by John E. Codman, hydrographer of the water department of Philadelphia, are given in the following table:

Daily discharge, in second-feet, of Perkiomen Creek at Frederick, Pa.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	269	119	2,657	246	253	47	226	69	51	877	128	172
2	249	228	1,598	199	196	45	124	68	39	394	117	283
3	193	375	703	157	194	51	79	58	33	215	113	1,190
4	168	307	400	142	191	51	102	45	31	158	109	409
5	143	236	284	133	162	45	107	45	26	596	104	361
6	114	168	315	270	140	45	67	45	26	1,185	102	270
7	111	121	301	345	123	45	59	51	26	358	107	204
8	111	75	284	1,638	109	45	54	49	26	228	161	224
9	111	75	1,443	1,564	96	45	51	43	77	158	83	209
10	111	75	2,840	738	88	45	43	43	171	119	65	194
11	101	66	1,753	426	79	45	43	49	69	380	51	184
12	92	51	835	301	74	45	45	212	38	2,350	71	318
13	92	45	828	238	75	45	43	114	31	522	75	257
14	83	45	497	188	79	56	38	50	28	288	75	220
15	66	45	352	166	79	67	35	49	29	219	73	209
16	58	45	323	154	73	71	35	37	28	193	72	4,200
17	51	45	972	150	61	83	49	24	26	165	89	3,440
18	45	45	406	143	53	79	43	30	28	140	104	751
19	45	45	273	134	57	67	40	33	28	133	92	698
20	45	45	235	119	66	62	75	34	26	123	84	587
21	1,084	137	219	114	69	61	82	38	26	110	79	3,334
22	5,259	1,798	198	118	67	103	113	39	26	101	55	5,011
23	388	800	178	112	64	66	66	32	28	99	46	905
24	221	485	163	105	56	54	53	20	30	95	79	522
25	160	1,104	143	100	59	54	113	18	44	89	106	405
26	142	6,035	123	95	65	227	150	30	1,379	78	434	367
27	688	2,569	118	88	77	143	73	38	1,684	71	438	332
28	238	6,843	123	86	96	101	58	254	360	1,045	295	292
29	194	.....	944	159	84	68	58	324	313	428	188	279
30	168	.....	765	581	61	175	58	101	186	260	147	267
31	139	.....	341	.....	51	.....	66	69	.....	163	.....	243

Estimated monthly discharge of Perkiomen Creek at Frederick, Pa.

[Drainage area, 152 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	5,259	45	353	2.32	2.67
February	6,843	45	787	5.18	5.39
March	2,840	118	665	4.38	5.05
April	1,638	86	300	1.97	2.20
May	253	51	97	.64	.74
June	227	45	71	.47	.52
July	226	35	72	.47	.54
August	324	18	68	.45	.52
September	1,684	26	164	1.08	1.20
October	2,350	71	366	2.41	2.78
November	438	46	123	.81	.90
December	5,011	172	850	5.59	6.44
The year	6,843	18	326	2.15	28.95

WISSAHICKON CREEK NEAR PHILADELPHIA, PA.

The drainage basin of this creek is immediately adjacent to Phila-elphia, and between Little Neshaminy and Perkiomen creeks. It ows through Fairmount Park, emptying into the Schuylkill River bout 12 miles from its mouth. Measurements of flow were begun in pril, 1897, under the direction of John E. Codman, at a point about 00 yards above the junction of the creek with Schuylkill River. une 5, 1899, the observations were discontinued temporarily, and ere not again resumed until July 1, 1900. The figures for monthly ow for 1899 and diagrams of daily discharge for the entire period of bservation (1897 to 1899, inclusive) will be found in the Twenty-first nnual Report, Part IV, pages 81 and 82. The following figures for 902 were furnished by Mr. Codman.

Daily discharge, in second-feet, of Wissahickon Creek near Philadelphia, Pa.

Day.	Jan.	Feb.	Mar.	Apr.	May.
1902.					
1	163	22	1,967	114	123
2	153	146	870	106	96
3	112	162	485	102	96
4	99	138	198	102	106
5	93	49	104	106	96
6	77	22	119	106	82
7	63	22	148	106	77
8	45	22	184	490	77
9	42	22	247	415	77
10	44	22	267	183	77
11	32	22	255	161	82
12	31	22	255	157	86
13	31	22	247	140	82
14	31	22	227	123	70
15	31	22	195	106	63
16	31	22	168	106	61
17	27	22	155	114	51
18	22	22	118	114	44
19	22	22	104	106	44
20	22	22	143	106	47
21	151	22	161	98	47
22	1,003	398	148	91	[a] 40
23	101	557	140	91	.....
24	84	270	141	89	.....
25	68	334	141	84	.....
26	77	1,511	131	82	.....
27	171	1,821	123	72	.....
28	124	1,983	124	72	.....
29	26	.....	127	111	.....
30	25	.....	207	168	.....
31	24	.....	128	.....	.....

[a] Water drained out of pond for repairs.

TOHICKON CREEK AT POINT PLEASANT, PA.

Tohickon Creek drains an area of 162 square miles in Bucks County, north of Philadelphia. It flows in an easterly course, entering Delaware River about 8 miles above Lambertville, N. J. In a statement by Rudolph Hering, printed in the report of the Philadelphia water department for 1885, on page 350, is given a classification of the drainage area of Tohickon Creek, from which it appears that 76 square miles is cultivated and improved and 26 square miles untillable and wooded. Measurements of the discharge of the creek are made near its mouth at Point Pleasant. Rain gages are located within the drainage basin at Quakertown, also at a point about 3 miles north of Bedminster, and near Point Pleasant.

Tables of daily discharge in second-feet, for the years 1883 to 1899 inclusive, are published in Water-Supply Paper No. 47, page 81. Daily records of gage height were not kept during 1900. The following figures of discharge for 1902 were furnished by Mr. Codman.

Daily discharge, in second-feet, of Tohickon Creek at Point Pleasant, Pa.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	339	206	5,958	142	166	10	69	18	3	363	64	107
2	201	357	551	112	65	7	51	20	2	351	55	136
3	135	584	460	78	65	7	40	20	4	214	51	1,359
4	87	708	348	58	73	5	34	12	4	114	48	430
5	87	528	175	50	61	5	26	16	3	1,227	45	274
6	87	266	185	96	47	3	21	13	3	1,500	41	215
7	87	184	212	297	35	3	19	17	2	430	41	148
8	79	157	153	1,523	31	4	19	12	2	162	39	124
9	71	109	1,089	1,772	27	5	16	7	13	92	94	107
10	71	102	1,977	589	23	6	9	6	6	68	94	107
11	71	102	1,280	286	20	5	11	12	8	612	32	68
12	71	79	775	133	22	3	13	37	6	2,616	30	102
13	64	71	741	96	22	4	6	37	6	909	31	103
14	58	71	539	83	18	10	8	27	6	227	29	119
15	53	55	246	67	17	10	9	17	4	119	32	119
16	48	34	291	56	17	8	9	15	7	87	30	2,505
17	48	26	1,197	48	17	12	9	14	6	70	26	3,367
18	43	23	488	45	12	12	5	12	5	57	26	1,024
19	39	17	159	43	15	10	3	17	6	50	23	444
20	39	10	110	38	20	9	4	15	5	48	22	429
21	614	34	98	35	12	7	7	11	4	48	21	1,999
22	2,969	710	88	34	9	13	33	11	4	41	22	4,260
23	407	675	80	31	9	6	26	12	5	36	88	1,854
24	124	642	72	27	9	8	260	8	5	39	92	353
25	82	582	60	20	7	9	515	8	7	34	31	147
26	59	3,406	49	16	7	19	180	8	1,129	26	337	54
27	300	2,419	48	16	10	24	81	4	2,291	23	435	75
28	114	5,216	85	20	12	23	44	4	1,536	1,304	189	84
29	131	------	996	23	14	45	39	4	734	526	94	205
30	102	------	772	251	9	110	37	3	830	189	71	337
31	137	------	226	------	12	------	23	3	------	97	------	157

Estimated monthly discharge of Tohickon Creek at Point Pleasant, Pa.

[Drainage area, 102 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
anuary	2,969	39	220	2.16	2.49
ebruary	3,406	10	620	6.08	6.33
arch	5,958	48	629	6.17	7.11
pril	1,772	16	203	1.99	2.22
ay	166	7	28	.27	.31
une	110	3	13	.13	.15
uly	515	3	52	.51	.59
ugust	37	3	14	.14	.16
eptember	2,291	2	222	2.18	2.43
ctober	2,616	23	377	3.70	4.27
ovember	435	21	74	.73	.81
ecember	4,260	54	671	6.58	7.59
The year	5,958	2	260	2.55	34.46

NESHAMINY CREEK, PENNSYLVANIA, BELOW THE FORKS.

The drainage basin of Neshaminy Creek is immediately south of that of Tohickon Creek and of a portion of that of Perkiomen Creek. The stream flows in a general southeasterly and southerly course, entering Delaware River at a point about 12 miles above Philadelphia. The point of measurement is at the forks of Big and Little Neshaminy creeks. The drainage area at this point is 139.3 square miles, of which 128.2 are cultivated and improved and 11.1 miles untillable and wooded. The daily discharges from 1884 to 1900 are given in Water-Supply Paper No. 47, pages 90 to 98. The following table of daily discharge for 1902 was furnished by Mr. Codman:

Daily discharge, in second-feet, of Neshaminy Creek below the forks, Pennsylvania.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	224	223	2,553	190	129	22	103	52	24	2,375	136	328
2	318	551	1,414	148	84	22	61	32	23	464	125	246
3	223	753	619	121	93	19	41	87	17	237	115	1,083
4	144	540	264	114	93	17	36	358	16	194	105	377
5	144	474	225	114	81	17	31	42	16	1,787	105	373
6	144	381	176	145	70	18	28	72	15	2,063	105	323
7	144	176	229	248	57	20	28	80	15	379	105	213
8	134	154	243	2,009	59	22	26	44	16	257	100	188
9	125	144	2,597	1,510	56	18	18	38	53	208	95	188
10	125	144	2,272	562	39	18	16	409	61	173	87	194
11	115	134	1,682	380	31	18	18	729	35	659	77	140
12	105	125	751	272	31	16	22	388	26	3,497	72	206
13	105	125	502	221	36	20	19	133	16	591	71	307
14	96	125	621	200	31	18	15	86	15	337	67	499
15	88	115	501	182	26	15	22	70	16	258	46	433
16	88	105	309	154	26	25	24	55	16	218	43	3,174
17	88	105	1,283	144	26	33	20	49	15	194	59	2,718
18	88	105	445	134	23	26	16	49	14	181	46	656
19	88	105	235	125	21	20	16	39	14	169	42	506
20	80	105	186	113	26	16	15	37	15	152	50	560
21	619	329	179	99	31	308	12	40	15	137	50	2,682
22	3,226	3,043	175	93	31	157	13	24	15	125	51	2,708
23	352	1,495	154	81	31	49	15	30	15	115	48	610
24	183	604	144	72	31	36	481	36	13	110	52	42[illegible]
25	139	853	124	72	68	36	758	41	42	105	91	34[illegible]
26	134	6,063	115	73	70	175	168	36	1,399	102	255	26[illegible]
27	601	3,438	125	64	49	79	55	95	1,249	107	282	21[illegible]
28	368	4,041	153	60	55	30	31	100	379	1,195	146	21[illegible]
29	188	.....	448	95	48	312	45	33	440	320	104	29[illegible]
30	164	.....	679	206	37	269	65	28	174	182	113	29[illegible]
31	154	.....	450	.....	24	.....	71	26	.....	150	.....	20[illegible]

Estimated monthly discharge of Neshaminy Creek below the forks, Pennsylvania.

[Drainage area, 139 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	3,226	80	284	2.04	2.35
February	6,063	105	877	6.31	6.57
March	2,597	115	640	4.60	5.30
April	2,009	60	267	1.92	2.14
May	129	21	49	.35	.40
June	312	15	62	.45	.50
July	758	12	74	.53	.61
August	729	26	108	.78	.90
September	1,399	13	139	1.00	1.12
October	3,497	102	550	3.96	4.57
November	282	42	95	.68	.76
December	3,174	140	676	4.86	5.60
The year	6,063	12	318	2.29	30.82

SCHUYLKILL RIVER NEAR PHILADELPHIA, PA.

This river receives the drainage of the portion of southeastern Pennsylvania lying between the Lehigh River on the north and the Susquehanna River on the south. It flows in a general southeasterly course, emptying into Delaware River, the city of Philadelphia being located at the junction of these streams. Records of the height of the river at Fairmount pool have been kept for many years, but not in such form as to be useful in computing daily discharges. In 1898, however, careful estimates were prepared by Mr. Codman, the results being given in the Twentieth Annual Report, Part IV, page 97.

The figures for daily discharge in the following table do not represent the total flow of the stream, but the amount wasted over the flashboards at Fairmount dam. To this must be added the pumpage from the river, also the leakage, and also the quantity used for power at Fairmount. The total discharge is given at foot of the table of monthly totals in cubic feet. There has been no method for obtaining the daily flow when the water does not waste over the flashboards. When the water is below the overflow line recourse is had to pumping, and the draft is on the storage of the pool. As soon as the water begins to rise after a rain the turbine wheels are started, and thus it often occurs that no water flows to waste for from one to three months in succession.

The following figures for 1902 were furnished by Mr. Codman:

Daily discharge, in second-feet, of Schuylkill River above Philadelphia, Pa., being the amount wasted over flashboards at Fairmount dam.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	1,817	953	82,156	2,712	1,537	.....	1,000	.....	.....	6,057	1,999	1,270
2	1,938	1,964	25,172	1,819	896	.....	305	.....	.....	4,814	1,831	1,12
3	3,814	6,747	12,765	1,267	605	.....	.....	.....	.....	2,300	1,605	3,60
4	2,120	4,556	5,297	1,308	92	.....	416	.....	.....	1,443	1,140	5,34
5	1,634	945	1,887	1,308	.....	.....	275	.....	.....	3,137	903	3,43
6	1,524	500	1,216	1,308	92	.....	.....	.....	.....	9,534	903	3,13
7	1,349	530	734	1,873	.....	.....	.....	.....	.....	4,484	903	2,53
8	1,349	44	1,200	5,726	.....	.....	.....	.....	.....	2,510	903	2,16
9	1,349	.....	2,720	16,336	.....	.....	.....	.....	.....	2,180	920	1,99
10	1,041	166	10,078	13,019	.....	.....	.....	450	.....	895	413	1,83
11	1,041	92	8,873	7,976	.....	.....	.....	1,378	183	744	122	1,52
12	674	176	5,331	5,260	.....	.....	.....	3,358	.....	11,323	122	2,46
13	367	44	5,200	4,078	.....	.....	.....	1,818	.....	7,614	122	3,13
14	245	.....	5,331	3,125	46	.....	.....	107	.....	4,498	122	2,35
15	119	45	5,331	2,489	92	.....	.....	.....	.....	3,038	171	1,99
16	260	.....	4,573	1,887	.....	.....	.....	.....	.....	2,100	171	12,76
17	119	78	5,358	1,699	637	.....	.....	.....	.....	1,459	283	30,10
18	134	.....	6,430	1,362	92	.....	.....	.....	.....	1,076	283	19,49
19	92	.....	4,666	1,026	92	.....	.....	.....	.....	819	225	11,28
20	32	.....	3,071	880	.....	.....	.....	.....	.....	676	171	5,08
21	1,005	383	3,040	497	.....	.....	.....	.....	.....	413	225	6,72
22	37,901	17,369	2,577	239	.....	.....	97	.....	.....	243	122	45,71
23	22,919	11,045	2,182	45	.....	.....	.....	.....	.....	199	171	40,39
24	8,004	5,364	1,705	302	.....	.....	.....	.....	.....	159	268	10,84
25	4,156	5,446	1,354	605	.....	.....	184	.....	.....	184	171	5,71
26	2,182	38,856	961	423	119	.....	.....	.....	2,104	225	972	3,80
27	3,280	37,172	702	314	.....	92	.....	.....	12,349	254	3,027	2,10
28	4,817	38,174	670	314	.....	.....	.....	.....	6,818	3,919	3,236	1,66
29	2,349	.....	1,634	487	.....	.....	.....	.....	4,078	6,168	1,318	1,31
30	1,187	.....	4,183	1,246	.....	571	315	.....	2,524	3,407	413	1,07
31	953	.....	4,183	.....	.....	.....	944	.....	.....	2,443	.....	86

Total monthly yield of Schuylkill River above Philadelphia, Pa., for 1902.

	Cubic feet.
January	14,403,100,000
February	18,278,000,000
March	24,203,300,000
April	11,673,500,000
May	4,407,600,000
June	2,382,700,000
July	3,589,200,000
August	3,248,400,000
September	4,283,500,000
October	12,229,700,000
November	5,741,800,000
December	24,847,000,000

SUSQUEHANNA RIVER DRAINAGE BASIN.

The North Branch of this river rises in New York State and flows in a southwesterly direction until it crosses the Pennsylvania State line, when it changes its course to the southeast, turns again, near Wilkesbarre, to the southwest and joins the West Branch on the western border of Northumberland County, to form the Susquehanna proper. The West Branch rises in Cambria County, Pa., and flows in a general northeasterly direction until it joins the North Branch. Measurements of flow of the North Branch are made at Binghamton, N. Y., and at Wilkesbarre and at Danville, Pa., and of the West Branch at Allenwood and at Williamsport, Pa. At Binghamton the Chenango River unites with the North Branch of the Susquehanna and a gaging station is located at this place. The Juniata River, which rises in Center County, Pa., flows into the Susquehanna about 15 miles above Harrisburg. Most of its drainage area is mountainous and covered with forest growth. A gaging station is located on this branch at Newport, about 15 miles above the junction of the river with the Susquehanna. On the main branch of the Susquehanna River measurements are being made at Harrisburg. The measurements at these stations are made by E. G. Paul and R. E. Horton.

CHENANGO RIVER AT BINGHAMTON, N. Y.

The gage on this stream is located on the upstream side of the first span from the right bank of Court street bridge, in Binghamton.

It consists of a horizontal wooden box containing a scale graduated in feet and tenths to 15.5 feet, secured to the vertical supports of the hand railing by means of U-bolts. At the zero end of the scale is placed a pulley over which passes the weight wire. The bench mark is a circular chisel draft in upstream corner of bridge seat on left-hand abutment. Elevation of bench mark, 100 feet; elevation of water surface when gage reads zero, 65.98 feet.

The Court street bridge stands squarely across the stream, which has a nearly horizontal bed of gravel and small cobblestones, affording a smooth uniform current for gaging. The channel is obstructed by three masonry piers supporting the four spans of the bridge, 79 feet clear width each, the bridge having a total length of 337 feet between abutments. The bridge is situated 2,500 feet above the mouth of Chenango River. A small rift below the bridge cuts off backwater from Susquehanna River at ordinary stages of the rivers. During freshets, when the gage readings may be affected by backwater, making them appear too large, check readings are taken at De Forest street bridge, 1.4 miles upstream.

During 1901 nine current-meter measurements were made through the cooperation of E. C. Murphy.

The gage reader, E. F. Weeks, takes readings of the river stage twice daily. During freshets additional readings are taken at frequent intervals at the Chenango and Susquehanna stations by the United States Weather Bureau, of which W. E. Donaldson is official in charge at Binghamton.

Three-fourths mile above the gage is located the dam of the Binghamton Cold Storage Company. Six water wheels are used under a head varying from zero to 5 feet, rated at a total of 150 horsepower. The dam is a low structure, giving but 3-foot fall. It consists of large blocks of bluestone laid dry, offering numerous leaks and crevices. The dam affords little obstruction to the flow of the stream, which passes the gage in nearly its normal regimen.[a]

The flow at Binghamton does not represent the entire natural run-off of the Chenango drainage basin, as a portion of the headwaters are diverted across the Chenango-Mohawk divide through Oriskany Creek to feed the Rome or summit level of Erie Canal.[b]

Additional diversion takes place from the headwaters of Tioughnioga River through Fayetteville feeder. De Ruyter reservoir, at the head of the feeder, which has a tributary drainage of 18 square miles, receives most of its supply from across the Chenango divide.

Nominal and effective drainage areas of Chenango River above Binghamton.

	Square miles.
Natural drainage area above Binghamton	1,582
Area tributary to canal storage reservoirs	105
Effective area above Binghamton during navigation season	1,477

Discharge measurements of Chenango River at Binghamton, N. Y.

Date.	Hydrographer.	Gage height.[c]	Discharge.
1901.		*Feet.*	*Second-feet.*
July 29	E. C. Murphy	5.21	405
July 29	do	5.21	425
August 19	do	5.48	566
August 19	do	5.49	577
July 2	do	5.64	848
July 9	do	5.71	942
July 8	do	5.78	1,119
October 19	do	5.81	[d]987
October 19	do	5.81	[d]927

[a] See description of Chenango River in "Report on water power," part 1, Tenth United States Census, 1880, Vol. XVI, pp. 583-585.

[b] See description of Oriskany Creek station, p. 79.

[c] Datum elevation 65.98 feet.

[d] Subject to revision.

Discharge measurements of Chenango River at Binghamton, N. Y.—Continued.

Date.	Hydrographer.	Gage height.	Discharge.
1902.		*Feet.*	*Second-feet.*
August 15	E. C. Murphy	6.08	1,341
August 14	do	6.20	1,608
July 15	do	6.56	2,098
June 6	R. E. Horton	6.58	2,407
July 3	E. C. Murphy	7.16	2,688
March 27	do	8.15	4,201
March 28	do	8.21	4,377
July 1	do	8.41	4,815
March 29	do	8.75	5,205
August 3	do	9.04	5,543

Mean daily gage height, in feet, of Chenango River at Binghamton, N. Y.[a]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1								5.18	5.58	5.70	5.46	6.12
2								5.08	5.75	5.50	5.31	6.33
3								5.10	5.58	5.52	5.26	6.61
4								5.10	5.50	5.68	5.28	6.52
5								5.05	5.43	5.55	5.27	6.19
6								5.20	5.28	5.51	5.25	5.95
7								5.01	5.23	5.45	5.25	5.91
8								5.10	5.20	5.47	5.23	6.03
9								5.20	5.18	5.40	5.24	6.86
10								5.20	5.15	5.37	5.21	9.64
11								5.23	5.15	5.34	5.14	10.00
12								5.20	5.18	5.34	5.26	8.82
13								5.18	5.30	5.42	6.85	.....
14								5.13	5.48	6.47	6.45	8.48
15								5.15	5.85	6.41	6.20	19.54
16								6.35	5.43	6.08	6.11	18.02
17								5.90	5.55	5.89	6.10	12.61
18								5.60	5.63	5.85	6.06	9.42
19								5.48	5.55	5.80	6.06	8.11
20								5.40	5.45	5.82	6.00	7.40
21								5.55	5.45	5.78	5.96	6.84
22								5.58	5.30	5.75	5.96	6.67
23								5.48	5.23	5.70	5.94	6.77
24								6.70	5.20	5.67	6.72	8.18
25								6.20	5.25	5.57	7.78	7.42
26								5.65	5.24	5.48	7.19	6.89
27								5.38	5.25	5.45	6.64	6.84
28								5.30	.....	5.39	6.06	6.50
29								5.25	5.15	5.40	6.20	6.53
30								5.20	5.88	5.35	6.33	7.20
31								5.20	.....	5.39	.....	7.36

[a] Tables give actual gage readings. Datum changes from 65.98 to 65.57 August 21, 1902.

Mean daily gage height, in feet, of Chenango River at Binghamton, N. Y.—Cont'd.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	6.62	6.31	19.44	8.65	6.53	6.20	8.50	8.33	6.03	7.73	8.48	6.98
2	6.64	6.26	23.32	8.61	6.30	6.03	7.80	9.33	5.98	7.70	8.00	6.93
3	6.74	6.13	21.64	8.45	6.20	5.95	7.31	8.35	6.00	7.13	7.70	7.13
4	6.91	6.34	17.15	8.10	6.20	6.23	7.35	7.70	5.93	6.73	7.43	7.68
5	6.65	6.20	12.30	7.83	6.20	6.95	7.05	7.20	5.90	6.48	7.28	7.58
6	6.61	6.19	9.93	7.70	6.10	6.58	7.38	6.88	5.88	6.73	7.18	7.18
7	6.52	6.16	9.25	7.60	6.10	6.30	8.12	6.90	5.93	7.00	7.15	7.05
8	6.30	6.20	9.03	7.57	6.10	6.30	7.93	6.75	5.90	6.88	7.03	6.95
9	6.22	6.21	8.67	8.12	6.10	6.33	7.73	6.68	5.93	6.90	6.88	6.70
10	6.13	6.08	9.45	8.50	5.98	6.30	7.80	6.45	6.30	6.75	6.78	6.63
11	6.14	6.10	9.28	8.97	5.95	8.45	9.15	6.40	6.53	6.58	6.73	7.00
12	6.02	5.99	11.60	8.78	5.90	6.33	8.33	6.65	6.25	6.60	6.68	6.98
13	5.87	5.90	15.08	8.48	5.85	6.25	7.33	6.60	6.10	6.60	6.93	6.68
14	5.63	5.84	15.77	8.23	5.80	6.30	6.88	6.29	6.05	6.80	6.85	6.45
15	5.89	5.77	14.17	7.80	5.75	6.20	6.60	6.13	6.00	7.08	6.75	6.55
16	5.91	5.87	11.97	7.43	5.70	6.18	6.48	6.10	5.90	6.75	6.60	6.99
17	5.89	5.76	15.87	7.18	5.73	6.20	6.48	5.98	5.85	6.55	6.55	10.97
18	5.76	5.78	15.72	7.05	5.70	6.10	6.40	5.93	5.80	6.45	6.53	11.38
19	5.78	5.74	13.10	6.90	5.60	6.00	6.73	5.88	5.80	6.40	6.50	10.35
20	5.78	5.71	10.47	6.80	5.75	6.00	11.57	5.88	5.75	7.25	6.55	9.53
21	5.67	5.64	9.40	6.70	6.00	5.95	14.98	6.15	5.73	7.30	6.50	8.95
22	6.02	5.67	9.20	6.63	5.88	6.20	14.90	6.44	5.70	6.95	6.53	13.29
23	8.24	5.68	9.32	6.50	5.78	6.25	13.40	6.35	5.75	6.78	6.53	14.47
24	8.66	5.67	9.38	6.38	5.83	6.08	12.22	6.33	5.73	6.75	6.60	11.72
25	7.62	5.69	8.90	6.30	5.95	5.93	11.35	6.28	5.75	6.75	6.65	9.75
26	6.87	5.73	8.47	6.18	6.30	5.98	9.60	6.25	5.98	6.65	6.73	9.15
27	6.86	6.08	8.15	6.18	6.58	6.10	8.50	6.15	6.20	6.60	7.23	8.68
28	7.28	8.42	8.15	6.13	6.30	6.08	11.50	6.23	6.10	10.19	7.50	8.08
29	7.39	.....	8.90	6.13	6.20	6.65	9.58	6.18	8.08	12.15	7.23	7.68
30	6.86	.....	9.28	6.28	6.18	10.48	8.50	6.18	6.88	10.85	7.05	7.73
31	6.41	.....	8.97	.....	6.15	.....	9.18	6.10	.....	9.30	.....	7.43

SUSQUEHANNA RIVER AT BINGHAMTON, N. Y.

A gaging station was established on this stream July 31, 1901. The gage is located on the upstream side of the left span of the Washington street bridge. This bridge is situated about 800 feet upstream from the junction of Chenango and Susquehanna rivers. A rift extends diagonally across the stream underneath the bridge. The gage stands above a stretch of smooth water extending from the crest of the rift to the dam, 2,800 feet upstream, and the gage readings are unaffected by backwater from Chenango River at ordinary stages. Owing to unfavorable conditions underneath the Washington street bridge, discharge measurements are made at Exchange street bridge, 1,900 feet upstream. The gage is of the weight-and-wire variety, reading to feet and tenths, its datum being determined as follows:

Bench mark, chisel draft on corner left-hand bridge abutment, upstream side, elevation	100.00
Elevation water surface, when gage reads zero	76.29

The gage is read twice daily by E. F. Weeks.

There are no tributaries of noticeable magnitude entering between the gaging stations on the Chenango and Susquehanna rivers at Binghamton and the junction of the two streams. Simultaneous discharge measurements of the two streams were made on several occasions. By combining the flow of the two branches, that of the Susquehanna below the junction at Binghamton has been obtained, as follows:[a]

By taking levels of high-water marks furnished by the mill owners, the following data relative to flood discharge of Susquehanna River have been obtained:

Flood discharge of Susquehanna River.

Date.	Depth on crest of present dam.	Estimated discharge.
	Feet.	*Second-feet.*
March, 1865	13.8	-------
Highest since 1865 (prior to 1901)	9.0	41,000
1898 and 1899	9.0	38,000
1901 (spring)	7.4	38,000

A current-meter measurement made at the highway bridge at Union, N. Y., by R. E. Horton, June 6, 1902, showed a discharge of 5,475 second-feet. Elevation of water surface referred to Delaware, Lackawanna and Western Railroad datum, 803.88. The drainage area at Union is 4,032 square miles. The accompanying tables show the progress of the floods of December 15–16, 1901, and March 1–2, 1902; the latter exceeded all known previous floods except that of 1865. The following comparative data have been obtained from these two floods at Binghamton and at Union highway bridge, 8.8 miles below the gaging station. Elevations were referred to the Delaware, Lackawanna and Western Railroad datum or mean tide at Sandy Hook.

Elevation of water surface of Susquehanna River at Binghamton and Union.

Flood.	Elevation at Binghamton.	Elevation at Union.	Fall.
			Feet.
December 15–16, 1901	835.67	820.59	15.08
March 1–2, 1902	839.77	826.71	13.06
——— —, 1865	840.00	827.82	12.18

From the stage and slope as given above and from cross sections obtained, the discharge during these freshets has been calculated by means of the Kutter formula. The coefficient of roughness $n=0.040$

[a] See description Chenango River, page 143.

has been used, this value having been calculated from observed slopes and measured discharges at lower stages of the stream.

Flood discharge of Susquehanna River, estimated by Kutter formula.

Flood.	Estimated discharge.	Per square mile.
	Second-feet.	*Second-feet.*
December 15-16, 1901	67,160	16.7
March 1-2, 1902	104,470	25.9
———, 1865	104,770	26.0

Total flow of Susquehanna River below junction.

1901.	Second-feet.
July 2-3	1,795
July 8-10	2,544
July 29-30	1,013
August 19-20	1,519
Do	1,518

Estimated drainage areas of Susquehanna and Chenango rivers, above Binghamton, N. Y.

	Square miles.
Susquehanna above Oneonta	686
Susquehanna above mouth of Unadilla River	914
Unadilla River above junction with Susquehanna	565
Susquehanna River below mouth of Unadilla River	1,479
Susquehanna, total drainage in New York above Chenango	1,900
Susquehanna, drainage in Pennsylvania above Chenango	500
Susquehanna River, total above Chenango River	2,400
Chenango River above Chenango Forks	694
Tioughnioga River above junction with Chenango River	753
Chenango River below mouth of Tioughnioga River	1,447
Chenango River above mouth	1,582
Susquehanna River below junction of Chenango River	3,982

The Susquehanna gage is located a short distance below the Binghamton Water Power dam, and the records show the amount passed by the turbines or wasting over spillway each day. The dam was built in 1833 by Whitney and Waterman. In 1869 it was repaired and its crest raised by the State of New York, and it now furnishes water power to four mills under an effective head of 6 feet.

Water-power privileges at Susquehanna River dam, Binghamton, N. Y.

Firm.	Business.	Water rights, etc.
H. J. Lyon's Sons	Saw and planing mill	First privilege, unlimited.
Luke Doolittle	Custom grinding	For 1 reaction water wheel.
Binghamton Box Co	Cigar boxes	Specified number of square inches.
Wilkinson Manufacturing Co.	Novelty works	Do.

The following tables show the variation of the gage readings during the floods of 1901 and 1902:

Variations in gage readings during flood of December 15–16, 1901, at Binghamton, N. Y.

Date.	Susquehanna River.		Chenango River.	
	Time.	Gage.	Time.	Gage.
December 15	8.45 a. m.	14.44	9.10 a. m.	18.73
	12.30 p. m.	14.94	11.00 a. m.	19.45
	5.30 p. m.	15.64	5.00 p. m.	20.45
December 16	8.00 a. m.	14.59	7.30 a. m.	18.63
	11.00 a. m.	14.19	11.30 a. m.	17.90
	4.30 p. m.	12.89	5.00 p. m.	16.50
December 17	7.50 a. m.	10.29	7.20 a. m.	13.73
			2.45 p. m.	12.20
			4.50 p. m.	11.90

Variations in gage readings during flood of March 1–2, 1902, at Binghamton, N. Y.

Date.	Susquehanna River.		Chenango River.	
	Time.	Gage.[a]	Time.	Gage.
February 28	7.35 a. m.	3.54	7.15 a. m.	5.95
	2.00 p. m.	5.44	1.20 p. m.	8.50
	4.30 p. m.	7.84	5.00 p. m.	11.32
March 1	7.25 a. m.	13.79	7.05 a. m.	17.38
	9.00 a. m.	14.09	8.45 a. m.	17.80
	10.50 a. m.	14.49	10.40 a. m.	18.10
	1.30 p. m.	14.99	1.05 p. m.	18.60
	3.10 p. m.	15.19	3.00 p. m.	19.10
	5.00 p. m.	16.54	4.00 p. m.	20.10
	7.20 p. m.	17.59	7.30 p. m.	21.50
March 2	7.40 a. m.	19.74	8.00 a. m.	22.80
	10.30 a. m.	18.69	11.00 a. m.	22.60
	1.55 p. m.	18.79	1.35 p. m.	22.60
	4.00 p. m.	18.79	4.20 p. m.	22.70
	7.35 p. m.	18.99	8.20 p. m.	22.90
			10.30 p. m.	23.10

[a] Referred to No. 1 or original gage.

Variations in gage readings during flood of March 1-2, 1902, at Binghamton, N. Y.—Continued.

Date.	Susquehanna River.		Chenango River.	
	Time.	Gage.	Time.	Gage.
March 3	7.55 a. m.	18.69	7.30 a. m.	22.50
	9.15 a. m.	18.39	9.00 a. m.	22.30
	1.30 p. m.	17.99	11.30 a. m.	21.95
	7.30 p. m.	16.99	1.00 p. m.	21.70
			3.40 p. m.	21.40
			7.00 p. m.	20.80
March 4	7.20 a. m.	14.89	7.00 a. m.	18.40
	1.15 p. m.	13.74	12.00 a. m.	17.30
	3.15 p. m.	13.34	3.25 p. m.	16.60
	5.00 p. m.	12.99	5.30 p. m.	16.30
March 5	7.45 a. m.	10.19	7.00 a. m.	13.65
	5.00 p. m.	8.49	4.30 p. m.	11.95
March 6	7.55 a. m.	6.79	7.30 a. m.	10.25
	4.45 p. m.	6.24		

Discharge measurements of Susquehanna River at Binghamton, N. Y.

Date.	Hydrographer.	Gage height.[a]	Discharge.
1901.		*Feet.*	*Sec.-ft.*
July 30	E. C. Murphy	1.99	608
August 20	do	2.09	942
Do	do	2.10	689
July 3	do	2.12	947
July 10	do	2.35	1,425
August 23	do	2.64	2,176
August 22	do	2.94	2,983
Do	do	3.23	3,752
August 21	do	4.64	7,244
1902.			
August 16	E. C. Murphy	2.50	1,920
August 15	do	2.61	2,105
July 14	do	2.96	3,064
July 1	do	3.90	5,230
July 2	do	4.08	5,839
August 4	do	4.59	6,902
August 3	do	5.08	8,633

[a] All gage readings reduced to original gage (No. 1). Datum = 76.29.

Daily gage height, in feet, of Susquehanna River at Binghamton, N. Y.[a]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	.....	.....	.....	.....	.....	.....	.....	1.87½	2.25	2.75	2.6	3.05
2	.....	.....	.....	.....	.....	.....	.....	2.0	2.2	2.75	2.57	3.05
3	.....	.....	.....	.....	.....	.....	.....	1.95	2.2	2.72½	2.5	3.2
4	.....	.....	.....	.....	.....	.....	.....	1.9	2.25	2.72½	2.5	3.12
5	.....	.....	.....	.....	.....	.....	.....	1.9	2.22½	2.7	2.52	3.2
6	.....	.....	.....	.....	.....	.....	.....	1.9	2.2	2.62½	2.5	3.0
7	.....	.....	.....	.....	.....	.....	.....	1.9	2.1	2.6	2.5	2.88
8	.....	.....	.....	.....	.....	.....	.....	1.95	2.07½	2.55	2.5	2.9
9	.....	.....	.....	.....	.....	.....	.....	1.95	2.07½	2.6	2.47	3.0
10	.....	.....	.....	.....	.....	.....	.....	1.9	2.0	2.55	2.5	5.76
11	.....	.....	.....	.....	.....	.....	.....	1.97½	2.02½	2.57½	2.47	6.68
12	.....	.....	.....	.....	.....	.....	.....	1.97½	2.1	2.52½	2.52	5.88
13	.....	.....	.....	.....	.....	.....	.....	1.95	2.07½	2.55	3.05	.....
14	.....	.....	.....	.....	.....	.....	.....	2.0	2.05	2.62½	3.52	5.18
15	.....	.....	.....	.....	.....	.....	.....	1.97½	2.12½	2.7	3.35	15.42
16	.....	.....	.....	.....	.....	.....	.....	1.97½	2.2	2.87½	3.10	14.3
17	.....	.....	.....	.....	.....	.....	.....	2.0	2.25	2.95	3.0	9.8
18	.....	.....	.....	.....	.....	.....	.....	2.15	2.4	.....	2.98	6.22
19	.....	.....	.....	.....	.....	.....	.....	2.2	2.4	2.82½	2.92	4.85
20	.....	.....	.....	.....	.....	.....	.....	2.1	2.37½	2.8	2.95	3.05
21	.....	.....	.....	.....	.....	.....	.....	3.7	2.27½	2.8	2.95	3.52
22	.....	.....	.....	.....	.....	.....	.....	3.02½	2.2	2.82½	2.88	3.32
23	.....	.....	.....	.....	.....	.....	.....	2.65	2.1	2.8	2.85	4.3
24	.....	.....	.....	.....	.....	.....	.....	4.55	2.1	2.75	3.28	5.22
25	.....	.....	.....	.....	.....	.....	.....	3.9	2.1	2.7	3.98	4.52
26	.....	.....	.....	.....	.....	.....	.....	3.25	2.07½	2.65	3.5	3.88
27	.....	.....	.....	.....	.....	.....	.....	2.82½	2.3	2.62½	3.08	3.88
28	.....	.....	.....	.....	.....	.....	.....	2.5	.....	2.62½	2.8	3.42
29	.....	.....	.....	.....	.....	.....	.....	2.4	2.57½	2.6	2.9	3.45
30	.....	.....	.....	.....	.....	.....	.....	2.3	2.6	2.6	2.95	3.25
31	.....	.....	.....	.....	.....	.....	1.95	2.35	.....	2.12½	.....	4.62

[a] Means of actual readings of gage. Datum as follows:

July 31, 1901, to September 26, 1901	76.29
September 27, 1901, to March 27, 1902	75.88
After March 27, 1902	75.65

Mean daily gage height, in feet, of Susquehanna River at Binghamton, N. Y.—Continued.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1	3.78	3.10	16.10	5.95	3.60	3.10	5.85	5.65	2.88	5.33	5.35	3.50
2	3.95	3.10	19.39	5.85	3.60	3.13	4.98	6.68	2.88	5.00	4.83	3.48
3	3.78	3.13	18.39	5.60	3.50	3.05	4.35	6.02	2.88	4.43	4.45	3.60
4	4.13	3.80	14.26	5.30	3.40	3.38	4.63	5.25	2.90	4.10	4.23	3.85
5	3.78	3.53	9.75	4.95	3.40	3.83	4.18	4.53	2.88	3.65	4.03	4.08
6	3.70	3.23	6.92	4.89	3.43	3.60	4.73	4.20	2.83	3.68	3.88	3.93
7	3.58	3.28	6.15	4.65	3.33	3.38	5.18	4.13	2.80	3.58	3.83	3.68
8	3.38	3.30	5.90	4.58	3.28	3.33	5.10	3.85	2.85	3.53	3.75	3.53
9	3.23	3.35	5.60	5.50	3.20	3.40	4.75	3.73	2.83	3.50	3.58	3.48
10	3.10	3.28	6.30	6.15	3.20	3.35	4.78	3.58	3.00	3.43	3.53	3.60
11	3.08	3.40	6.15	6.45	3.10	3.23	5.53	3.48	3.00	3.30	3.45	3.58
12	3.25	3.20	8.37	6.20	3.08	3.23	5.13	3.50	3.00	3.43	3.40	3.70
13	3.13	2.98	11.75	5.78	3.05	3.33	4.18	3.55	2.98	3.53	3.40	3.58
14	3.03	2.90	12.50	5.45	3.05	3.33	3.53	3.50	2.90	3.65	3.50	3.43
15	2.90	2.80	11.17	5.10	3.03	3.40	3.50	3.35	2.90	3.65	3.43	3.50
16	2.88	2.88	8.98	4.73	3.00	3.40	3.45	3.24	2.85	3.63	3.30	3.69
17	2.80	2.75	18.57	4.45	3.00	3.28	3.38	3.15	2.80	3.50	3.30	7.89
18	2.78	2.70	12.43	4.28	2.90	3.30	3.40	3.10	2.80	3.35	3.28	8.40
19	2.98	2.73	10.02	4.13	2.90	3.25	3.40	3.05	2.80	3.25	3.23	7.45
20	3.20	2.73	7.38	3.93	2.90	3.25	7.53	3.05	2.75	3.35	3.25	6.63
21	2.70	2.75	6.27	3.83	3.00	3.20	11.80	3.10	2.70	3.50	3.20	6.03
22	3.13	2.68	6.05	3.73	3.08	3.23	12.10	3.10	2.70	3.48	3.20	10.20
23	5.33	2.88	6.17	3.60	3.10	3.33	10.75	3.03	2.75	3.33	3.23	11.37
24	5.73	2.85	6.32	3.43	3.00	3.25	9.65	3.03	2.73	3.28	3.20	8.95
25	4.78	2.73	6.00	3.38	2.95	3.13	8.85	3.00	2.75	3.28	3.23	7.03
26	3.95	2.68	5.47	3.30	3.13	3.03	7.12	3.00	3.10	3.25	3.28	6.38
27	3.70	2.98	5.12	3.25	3.30	3.13	6.15	2.95	3.38	3.20	3.45	5.73
28	4.23	5.50	5.00	3.28	3.28	3.13	8.27	3.00	3.30	7.10	3.60	5.23
29	4.58	.....	6.05	3.28	3.23	3.60	6.60	3.03	5.75	9.05	3.65	4.70
30	3.90	.....	6.45	3.35	3.15	3.68	5.55	3.03	4.55	7.90	3.58	4.55
31	3.43	.....	6.27	.....	3.10	.....	6.15	2.93	.....	6.28	.....	4.38

NORTH BRANCH OF SUSQUEHANNA RIVER AT WILKESBARRE, PA.

Observations of fluctuations of Susquehanna River are made by the Weather Bureau above Wilkesbarre, at Towanda, Pa., where the drainage area is estimated to be 8,000 square miles. The river gage, made of iron 1 foot wide and one-half inch thick, is on the east side of the road bridge over Susquehanna River, and is securely bolted to the masonry of the pier. The graduation is from 0 to 25 feet. The highest water was 29 feet in March, 1869, and the lowest, —0.1, in October, 1895. The danger line is at 16 feet. The elevation of the zero is 633.7 feet.

The Wilkesbarre station was established by E. G. Paul on March 30, 1899, and is located at the Market street bridge. The gage is a sash chain and weight inclosed in a long, narrow box, covering 12 feet of the scale board. The scale board is divided into feet and tenths

and painted the color of the ironwork. The length of the chain from zero to extreme end of weight is 40.83 feet. The initial point of sounding is at the end of the iron guard rail on the left bank. The channel is straight for a quarter of a mile above and below the station, the current sluggish but unobstructed. The right bank is low and liable to overflow; the left bank is above ordinary floods. The bed of the stream is of sand and gravel, somewhat shifting. The observer is W. S. Bennett, Wilkesbarre, Pa. When this gage was established there was found to be a gage painted on the bridge pier, being a portion of one established by the Weather Bureau. The lower part of this gage, erected in January, 1898, originally consisted of heavy cast-brass plates graduated to feet and tenths. The gage plates were made in 4-foot sections and bolted to the stone bridge pier. The two lower sections of the brass plates had been torn away by ice, so that there was no graduation below the 8-foot mark, but readings were made by the figures painted on the stone pier. The zero of this old gage is at the base of the dressed-stone portion of the pier, and is reported to be 535 feet above sea level. During low stages of the river the water recedes from the pier, rendering it impracticable to read the gage. So far as could be ascertained, this has not been connected with the city datum. On account of the low water, which in 1897 had gone below the city datum, it was decided to put the zero of the new gage 4 feet below the zero of the old Weather Bureau gage, so as to obviate minus readings. In order, therefore, to compare with former records, it is necessary to add 4 feet to the old figures. The danger mark of this Weather Bureau gage is at 14 feet, or 18 feet of new gage, as at this elevation the west bank of the river is under water in places. River reports from this locality were furnished as early as 1888. During low water, measurements were made by wading at a better cross section, at Retreat, 10 miles below Wilkesbarre. A bench mark was established September 26, 1900, being the extreme west end of the stone doorsill of the north entrance to the Coal Exchange Building, at 32.99 feet above datum of the gage. During 1902 measurements of discharge were made by Mr. Paul, as follows:

September 20: Gage height, 3.1 feet; discharge, 2,170 second-feet.

Daily gage height, in feet, of North Branch Susquehanna River at Wilkesbarre, Pa.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	14.00	12.70	29.57	9.70	5.00	4.10	10.60	8.80	3.60	9.60	9.50	5.10
2	13.00	11.40	30.75	9.20	4.90	4.00	10.50	9.50	3.50	10.80	8.20	5.00
3	12.10	10.80	30.05	9.00	5.10	3.90	8.30	11.10	3.40	10.60	7.40	5.00
4	10.90	10.70	25.25	8.50	5.10	3.90	7.80	9.60	3.40	8.50	6.80	5.20
5	9.60	8.50	20.20	8.10	4.80	3.80	8.50	8.80	3.20	7.30	6.40	5.50
6	9.90	7.00	14.65	7.90	4.80	3.80	8.26	7.50	3.20	7.10	6.00	5.90
7	9.80	9.10	11.65	7.60	4.70	4.80	12.70	6.80	3.20	6.90	5.80	5.80
8	9.60	9.80	10.70	7.70	4.70	4.50	14.20	6.50	3.20	6.70	5.50	5.50
9	9.70	9.60	10.30	11.85	4.50	4.40	13.15	6.20	3.20	6.20	5.60	5.20
10	9.40	9.40	11.00	15.80	4.40	4.20	8.75	5.80	3.20	5.80	5.70	5.90
11	9.20	9.00	12.50	15.45	4.30	4.20	9.00	5.60	3.60	5.50	5.00	7.20
12	9.00	9.00	14.80	12.80	4.20	4.20	9.70	5.50	3.50	5.80	4.70	8.00
13	8.20	9.00	18.00	14.40	4.10	4.10	8.50	5.40	3.60	6.50	4.70	9.85
14	7.20	8.30	19.60	10.30	4.00	4.20	7.40	5.40	3.50	6.00	4.70	10.20
15	6.40	8.00	18.20	9.40	3.90	4.20	6.30	5.20	3.50	5.80	4.70	9.20
16	6.80	8.20	15.80	8.60	3.80	4.20	5.80	5.00	3.40	5.90	4.60	10.70
17	7.20	7.80	18.50	8.00	3.80	5.00	5.40	4.60	3.30	5.90	4.50	13.45
18	7.00	7.70	20.20	7.40	3.70	4.70	5.20	4.40	3.30	5.60	4.40	12.70
19	6.70	7.20	17.45	7.00	3.70	4.40	5.10	4.20	2.20	5.30	4.30	12.40
20	6.10	6.60	14.30	6.70	3.60	4.60	5.40	4.10	3.10	4.90	4.20	11.30
21	6.20	6.60	11.60	6.40	3.50	4.30	12.10	4.00	3.10	4.80	4.20	10.00
22	10.60	6.50	10.20	6.20	3.50	4.30	15.90	4.00	3.00	4.90	4.20	15.60
23	16.70	6.40	9.70	6.00	3.50	4.20	13.90	4.00	3.00	5.20	4.10	17.65
24	12.20	7.20	9.60	5.70	3.70	4.20	13.45	3.90	3.00	5.00	4.10	16.35
25	10.70	7.20	9.50	5.50	3.70	4.20	13.85	3.90	3.00	4.70	4.10	13.70
26	9.70	7.70	9.00	5.20	3.70	4.20	14.90	3.80	4.20	4.70	4.10	11.00
27	8.90	8.80	8.50	5.00	3.80	4.10	11.70	3.70	7.10	4.60	4.50	9.70
28	8.20	14.03	8.00	4.80	3.90	3.90	9.70	3.60	6.00	7.62	4.70	8.50
29	7.70	.....	9.00	4.70	4.60	3.80	10.80	3.60	7.90	11.05	5.00	8.00
30	7.60	.....	10.40	4.90	4.60	5.10	10.60	3.60	10.70	12.05	5.20	7.00
31	13.30		9.80	.....	4.20	.....	9.30	3.60	.....	11.10	.....	6.80

Rating table for North Branch of Susquehanna River at Wilkesbarre, Pa., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.2	1,000	4.6	4,340	7.0	13,600	13.0	47,200
2.4	1,200	4.8	4,760	7.5	16,400	13.5	50,000
2.6	1,400	5.0	5,200	8.0	19,200	14.0	52,800
2.8	1,600	5.2	5,700	8.5	22,000	14.5	55,600
3.0	1,860	5.4	6,250	9.0	24,800	15.0	58,400
3.2	2,120	5.6	6,850	9.5	27,600	15.5	61,200
3.4	2,400	5.8	7,560	10.0	30,400	16.0	64,000
3.6	2,700	6.0	8,340	10.5	33,200	16.5	66,800
3.8	3,000	6.2	9,240	11.0	36,000	17.0	69,600
4.0	3,300	6.4	10,260	11.5	38,800	.....	.....
4.2	3,600	6.6	11,360	12.0	41,600	.....	.....
4.4	3,940	6.8	12,480	12.5	44,400	.....	.....

Estimated monthly discharge of North Branch Susquehanna River at Wilkesbarre, Pa.

[Drainage area, 9,810 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	67,920	8,770	27,123	2.76	3.19
February	52,968	10,260	23,247	2.37	2.47
March	146,768	19,200	59,086	6.02	6.94
April	62,880	4,540	21,633	2.21	2.47
May	5,450	2,550	3,679	.37	.43
June	5,950	3,000	3,732	.38	.42
July	63,440	5,450	30,088	3.07	3.54
August	36,560	2,700	9,069	.92	1.06
September	34,320	1,860	4,511	.46	.51
October	41,880	4,340	13,878	1.41	1.63
November	27,600	3,450	6,890	.70	.78
December	73,240	5,200	26,138	2.66	3.07
The year	146,768	1,860	19,090	1.94	26.51

NORTH BRANCH OF SUSQUEHANNA RIVER AT DANVILLE, PA.

This station, 52 miles below Wilkesbarre and 11 miles above the mouth of the West Branch, was established on March 25, 1899, by E. G. Paul. It is located at the Mill street bridge, 600 feet south of the public square, Danville, Pa. The equipment consists of a standard chain and weight gage referred to a horizontal scale board graduated to feet and tenths, inclosed in a lock box bolted to the hand rail on the lower side of the bridge, 200 feet from the right bank. The length of the chain from the zero to the extreme end of the weight is 42.85 feet. The initial point of soundings is at the end of the wooden hand rail on right bank. The channel is straight for half a mile above and below the station. The left bank is high, but the right bank is subject to overflow. The bed of the stream is rocky, with some gravel, and is unchangeable. A bench mark was established, being the extreme south end of the stone doorsill at the east entrance of the city filtering plant, at 31.7 feet above datum of the gage. During 1902 two measurements were made by Mr. Paul, as follows:

April 22: Gage height, 5.25 feet; discharge, 14,393 second-feet.
September 19: Gage height, 2.75 feet; discharge, 3,115 second-feet.

Daily gage height, in feet, of North Branch of Susquehanna River at Danville, Pa.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	6.60	4.85	20.67	7.85	4.40	3.50	6.10	7.70	3.10	8.95	7.05	4.30
2	6.20	5.05	24.43	7.60	4.30	3.40	8.95	7.75	3.00	9.15	6.36	4.20
3	5.40	(a)	26.07	7.40	4.20	3.30	7.40	8.70	3.00	9.05	5.80	4.20
4	5.50	.....	22.25	7.10	4.20	3.30	6.90	8.20	2.90	7.65	5.45	4.60
5	6.70	.....	18.20	6.65	4.20	3.30	6.90	7.20	2.90	6.75	5.20	4.70
6	(a)	.....	14.50	6.45	4.10	3.20	6.90	6.75	2.80	6.80	5.00	4.90
7	.....	.....	10.75	6.30	4.00	3.20	8.50	5.85	2.80	6.50	4.85	4.90
8	.....	.....	8.55	6.50	4.00	3.90	11.90	5.45	2.80	6.10	4.70	4.80
9	10.60	.....	8.35	7.30	3.90	3.70	10.45	5.20	2.70	5.60	4.70	4.70
10	9.45	.....	9.10	11.90	3.80	3.50	7.85	5.00	2.90	5.20	4.50	4.30
11	9.10	.....	10.25	13.10	3.80	3.50	7.25	4.70	3.00	4.90	4.30	4.20
12	9.30	.....	11.55	11.20	3.70	3.60	7.80	4.60	3.10	5.40	4.20	4.30
13	(a)	.....	14.15	9.75	3.60	3.50	7.90	4.50	3.00	6.00	4.10	4.40
14	.....	.....	16.15	8.65	3.50	3.50	7.20	4.50	3.10	5.60	4.00	5.00
15	.....	.....	15.55	7.70	3.50	3.60	5.55	4.40	3.10	5.25	3.90	6.50
16	.....	.....	13.95	7.05	3.40	3.60	5.15	4.30	3.00	5.10	3.90	7.80
17	.....	.....	14.25	6.60	3.30	3.70	4.85	4.10	2.90	5.10	3.90	9.40
18	.....	.....	16.60	6.35	3.30	4.10	4.60	3.80	2.80	5.00	3.80	10.30
19	.....	.....	15.60	6.15	3.20	4.00	4.40	3.70	2.70	4.70	3.70	10.60
20	.....	.....	12.80	5.90	3.10	3.80	4.40	3.60	2.60	4.50	3.60	9.40
21	.....	.....	10.95	5.45	3.10	3.80	5.30	3.50	2.60	4.20	3.60	8.80
22	16.30	.....	8.90	5.30	3.10	3.70	11.90	3.50	2.60	4.10	3.60	12.70
23	8.10	.....	8.00	5.10	3.00	3.60	12.00	3.40	2.60	4.20	3.50	14.80
24	9.45	.....	6.40	4.90	3.00	3.50	11.30	3.40	2.50	4.30	3.50	14.40
25	8.50	.....	7.20	4.70	3.20	3.50	10.90	3.40	2.60	4.20	3.50	11.80
26	7.40	.....	7.10	4.50	3.30	3.60	11.90	3.30	4.75	4.00	3.60	9.75
27	6.90	.....	7.05	4.30	3.20	3.70	10.20	3.20	6.85	5.60	3.80	8.40
28	6.75	13.75	6.65	4.10	3.30	3.70	8.30	3.20	6.20	8.90	3.90	7.60
29	6.40	.....	6.75	4.00	3.50	3.50	8.00	3.20	6.05	9.70	4.00	6.80
30	6.20	.....	8.15	4.30	3.80	4.20	9.30	3.10	7.95	9.35	4.20	6.30
31	5.55	.....	8.30	.....	3.70	.....	8.20	3.10	.....	8.20	.....	5.70

(a) Frozen January 6 to 8, 13 to 21, and February 3 to 27.

Rating table for North Branch of Susquehanna River at Danville, Pa., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.6	825	4.8	11,500	8.0	33,200	16.0	90,800
1.8	1,100	5.0	12,550	8.5	36,800	16.5	94,400
2.0	1,400	5.2	13,720	9.0	40,400	17.0	98,000
2.2	1,800	5.4	14,900	9.5	44,000	17.5	101,600
2.4	2,250	5.6	16,100	10.0	47,600	18.0	105,200
2.6	2,750	5.8	17,390	10.5	51,200	18.5	108,800
2.8	3,300	6.0	18,800	11.0	54,800	19.0	112,400
3.0	3,900	6.2	20,240	11.5	58,400	19.5	116,000
3.2	4,550	6.4	21,680	12.0	62,000	20.0	119,600
3.4	5,250	6.6	23,120	12.5	65,600	20.5	123,200
3.6	6,000	6.8	24,560	13.0	69,200	21.0	126,800
3.8	6,800	7.0	26,000	13.5	72,800	21.5	130,400
4.0	7,650	7.2	27,440	14.0	76,400	22.0	134,000
4.2	8,575	7.4	28,880	14.5	80,000	.....	.....
4.4	9,525	7.6	30,320	15.0	83,600	.....	.....
4.6	10,500	7.8	31,760	15.5	87,200	.....	.....

Estimated monthly discharge of North Branch of Susquehanna River, at Danville, Pa.

[Drainage area, 11,070 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January [a]	.....	.....	[b] 32,645	[b] 2.95	[b] 2.08
February [a]	.....	.....	.....	.....	.....
March	163,160	23,480	66,215	5.98	6.89
April	69,920	7,650	25,183	2.27	2.53
May	9,525	3,900	6,123	.55	.63
June	8,575	4,550	6,032	.54	.60
July	62,000	9,525	33,550	3.03	3.49
August	38,240	4,200	12,498	1.13	1.30
September	32,840	2,500	6,485	.59	.66
October	45,440	7,650	20,594	1.86	2.14
November	26,360	5,600	9,638	.87	.97
December	82,160	8,575	28,637	2.59	2.99

[a] Frozen, and no record for January 6 to 8, 13 to 21, and February 3 to 27.
[b] Partial month; 19 days.

WEST BRANCH OF SUSQUEHANNA RIVER AT WILLIAMSPORT, PA.

Observations of the water height on the West Branch have been made for several years from the Market street bridge. Bench mark and datum for observer's gage were established March 1, 1895, under the direction of Mr. George D. Snyder, city engineer, and since that time daily gage heights have been observed. F. A. Snyder, the present city engineer, supplies this office with daily gage-height reports. On August 16, 1901, a discharge measurement was made, and a United States Geological Survey standard chain gage was installed on the upper side of the bridge, for convenience in making the daily observations. The length of the chain from the zero to the extreme end of the weight is 42.29 feet. A bench mark cut in the face of the left bank abutment is 10 feet above the datum of the gage.

The following discharge measurements were made during 1902 by E. G. Paul:

April 20: Gage height, 3.9 feet; discharge, 9.318 second-feet.
September 18: Gage height, 0.41 feet; discharge, 1.006 second-feet.

Daily gage height, in feet, of West Branch of Susquehanna River at Williamsport, Pa.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	3.20	4.30	20.38	6.00	2.50	1.30	8.30	5.00	0.50	2.70	1.90	1.00
2	2.90	4.20	21.10	5.70	2.50	1.20	7.40	4.90	.60	4.10	1.70	1.30
3	2.60	5.00	16.45	5.30	2.40	1.20	6.40	4.60	.50	3.10	1.60	1.50
4	2.50	4.70	13.00	4.90	2.70	1.10	9.70	4.30	.50	2.50	1.50	2.20
5	2.40	4.50	10.00	4.50	2.70	1.10	10.80	3.80	.50	2.40	1.40	2.40
6	2.30	4.00	8.10	4.30	2.90	1.30	8.60	3.30	.40	2.30	1.40	2.50
7	2.30	3.90	6.80	4.50	2.90	1.20	8.80	3.10	.40	2.20	1.30	2.30
8	2.30	3.70	5.90	4.70	3.20	1.20	7.30	3.00	.40	2.20	1.40	2.30
9	2.40	3.60	5.30	13.30	3.40	1.10	6.30	2.80	.40	2.00	1.40	2.80
10	2.40	3.40	5.50	16.60	3.20	1.00	6.00	2.60	.60	1.80	1.30	1.90
11	2.40	3.30	6.30	12.90	3.00	1.10	7.70	2.40	.50	1.60	1.30	2.00
12	2.40	3.00	7.10	10.30	2.80	1.10	7.20	2.20	.50	1.40	1.20	2.30
13	2.40	2.90	9.60	8.40	2.60	1.30	6.30	2.50	.60	1.20	1.20	3.10
14	2.30	3.00	12.20	7.30	2.50	1.40	5.00	2.10	.50	1.00	1.10	4.40
15	2.10	2.60	10.80	6.30	2.40	1.60	4.20	1.90	.40	1.20	1.00	3.60
16	2.10	2.30	8.40	5.50	2.20	1.80	3.60	1.80	.40	1.30	1.00	3.00
17	2.00	2.10	13.80	5.00	2.00	1.90	3.10	1.60	.40	1.60	.90	5.80
18	2.00	2.10	12.70	4.70	1.90	2.00	3.30	1.50	.40	1.50	.90	8.10
19	1.80	2.50	10.00	4.30	1.80	2.00	3.70	1.40	.30	1.40	.90	6.40
20	1.60	2.20	8.10	3.90	1.70	1.80	4.40	1.30	.20	1.30	.80	5.30
21	2.00	1.90	6.80	4.40	1.70	1.80	5.80	1.20	.20	1.30	.90	5.10
22	5.30	2.20	6.00	3.50	1.70	1.70	6.80	1.40	.20	1.20	.90	8.00
23	6.73	1.90	5.40	3.20	1.60	1.50	6.30	1.30	.20	1.10	.90	10.70
24	4.50	1.80	5.00	2.90	1.60	1.40	5.70	1.10	.20	1.00	.90	9.10
25	4.50	1.80	4.50	2.80	1.60	[a].60	5.90	1.00	.50	1.00	1.00	7.20
26	4.00	2.00	4.20	3.30	1.60	1.50	5.80	.90	.90	.90	1.10	6.00
27	4.10	3.10	3.90	2.50	1.70	1.90	6.10	.80	2.30	.90	1.10	5.40
28	4.00	10.89	3.70	2.40	1.80	2.80	5.50	.40	2.60	1.30	1.10	4.10
29	3.90	.....	3.90	2.30	1.60	2.60	5.20	.50	2.80	1.20	1.00	4.40
30	4.10	.....	5.60	2.50	1.50	4.30	4.50	.60	2.30	1.50	1.00	3.60
31	[illegible]	.....	6.20	.....	1.40	.....	5.20	.50	.....	1.70	.....	2.50

[a] Splash on dam.

WEST BRANCH OF SUSQUEHANNA RIVER AT ALLENWOOD, PA.

The West Branch of Susquehanna River rises in Cambria County, Pa., and flows in a general northeasterly direction, meeting the North Branch on the western border of Northumberland County and forming Susquehanna River.

Observations of height of water on the West Branch have been made by the weather bureau at Lockhaven, Pa., 47 miles above Allenwood. The drainage area is given as 3,740 square miles, and the width of river 1,125 feet. The gage is in two sections. The lower section is painted on the side wall of the canal lock, and the upper is on the highway bridge over the river. The elevation of the zero is 555.7 feet. The highest water was 18 feet, on June 4, 1889, and the danger line is at 10 feet.

Below the junction of the North and West Branches of Susquehanna River observations have been made of height of water by the Weather Bureau at Selins Grove, 45 miles above Harrisburg. The drainage area is given as 17,600 square miles. The river at this point is about 1 mile wide, including an island 400 feet wide. The gage is on the west abutment of a railroad bridge.

A gaging station was established on the West Branch by E. G. Paul on March 25, 1899, at Allenwood, Pa., 20 miles above the junction with the North Branch. Measurements are made from the public highway bridge, one-fourth of a mile east of the railroad station at Allenwood. The wire gauge is 42.15 feet from zero to the end of the weight, and is referred to a pine-board scale fastened to ironwork of the bridge and divided into feet and tenths. The initial point of soundings is at the end of the iron guard rail on the right bank. The channel is straight for one-half a mile above and below the station. The current is sluggish, but unobstructed. The banks are low and subject to overflow at time of high water. The bed of the stream is rocky and constant. The observer is Frank L. Allen, a farmer, living 200 feet from the gage. A bench mark was established on September 24, 1900. It consists of a copper bolt set in the capstone of the wing wall on the lower side of the west end of the bridge, and is 33.19 feet above datum of the gage.

This station was discontinued in April, 1902, the station at Williamsport taking its place.

The following discharge measurement was made during 1902, by Mr. Paul:

April, 21: Gage height, 4.4 feet; discharge, 9,896 second-feet.

Daily gage height, in feet, of West Branch of Susquehanna River at Allenwood, Pa.

Day	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1902.					1902.				
1	3.80	5.40	21.60	6.40	17	3.20	4.70	12.20	.....
2	3.80	5.20	19.40	6.50	18	3.10	4.70	10.00	.....
3	3.60	4.90	15.50	6.50	19	3.10	4.70	8.60	.....
4	3.60	4.90	11.50	6.40	20	3.10	4.70	7.40	.....
5	3.50	4.90	8.20	5.80	21	3.40	4.70	6.70	.....
6	3.50	4.90	6.80	.....	22	7.40	4.70	6.40	.....
7	3.50	4.80	6.40	.....	23	6.80	6.50	5.70	.....
8	3.50	4.80	5.50	.....	24	6.60	7.00	5.40	.....
9	3.40	4.80	4.90	.....	25	6.50	7.40	5.20	.....
10	3.40	4.80	6.40	.....	26	6.30	5.50	4.80	.....
11	3.40	4.80	7.60	.....	27	6.20	5.90	4.70	.....
12	3.30	4.70	8.40	.....	28	5.90	9.70	5.00	.....
13	3.20	4.70	10.00	.....	29	5.90	.....	5.60	.....
14	3.20	4.60	8.90	.....	30	5.80	.....	6.10	.....
15	3.20	4.50	8.60	.....	31	5.40	.....	6.20	.....
16	3.20	4.70	8.80	.....					

JUNIATA RIVER AT NEWPORT, PA.

Juniata River rises in Center County, Pa., and flows in a general southeasterly direction into Susquehanna River 15 miles above Harrisburg. Its drainage area is mountainous and for the most part covered with forest growth. The station was established at Newport, about 15 miles above its junction with the Susquehanna, on March 21, 1899, by E. G. Paul. It is at the covered wagon bridge, 800 feet east of the public square, Newport, Pa. Equipment consists of a standard chain-and-weight gage referred to a horizontal scale board graduated to feet and tenths inclosed in a lock box attached to the bridge timbers inside of the structure near the right bank. The length of the chain from the zero mark to the extreme end of the weight is 39.54 feet. The initial point of soundings is at the end of the woodwork of the bridge on the right bank. The channel is straight for half a mile above and below the station. The current is swift and unobstructed. The banks are high and not subject to overflow. The bed of the stream is rocky and the section constant. The observer is A. R. Bortel, a laborer living in Newport, Pa., about 800 feet from the gage. The following measurements were made by E. G. Paul during 1902:

April 19: Gage height, 5 feet; discharge, 6,779 second-feet.
September 17: Gage height, 2.84 feet; discharge, 734 second-feet.

Daily gage height, in feet, of Juniata River at Newport, Pa.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	6.40	4.20	25.30	5.80	4.00	3.20	5.40	4.40	3.00	4.90	4.00	3.00
2	5.60	4.20	19.50	5.70	3.80	3.20	6.30	4.00	3.00	4.90	3.80	3.60
3	5.00	4.60	15.50	5.40	3.80	3.20	6.10	3.50	2.90	3.50	3.70	4.30
4	5.40	3.90	12.00	5.30	3.90	3.20	6.40	4.00	2.90	3.50	3.60	5.30
5	4.30	4.50	9.30	5.00	3.90	3.20	6.70	4.00	2.90	3.50	3.60	5.50
6	4.20	3.60	7.10	5.00	3.90	3.20	5.60	4.00	2.90	4.00	3.50	4.90
7	4.20	3.60	6.50	5.20	3.90	3.20	5.40	3.80	2.90	4.00	3.40	4.50
8	4.20	3.70	6.00	14.65	3.90	3.10	5.00	3.80	2.90	3.80	3.30	4.50
9	4.10	5.10	5.50	18.50	3.90	3.10	4.50	3.80	2.90	3.50	3.40	4.20
10	4.10	5.80	6.20	18.50	3.90	3.10	4.80	4.00	3.10	3.40	3.40	4.40
11	4.10	5.80	8.40	12.50	3.70	3.10	4.60	4.60	3.10	3.40	3.40	4.20
12	4.00	5.70	9.50	10.00	3.50	3.10	4.00	3.90	3.00	4.60	3.30	5.30
13	3.90	5.00	13.30	8.10	3.50	3.20	3.90	3.80	3.00	6.40	3.30	7.70
14	3.90	4.50	14.10	7.00	3.30	3.30	3.90	3.60	2.90	6.00	3.30	4.80
15	3.70	4.30	9.60	6.50	3.30	3.30	3.80	3.30	2.90	4.70	3.30	6.40
16	3.50	5.10	9.00	5.50	3.30	4.30	3.60	3.40	2.90	4.40	3.20	5.80
17	3.80	5.10	15.30	5.00	3.40	3.80	3.60	3.40	2.90	4.00	3.20	7.70
18	3.80	5.10	12.50	5.00	3.40	3.90	3.60	3.30	2.90	3.80	3.20	7.00
19	7.50	5.10	9.50	4.90	3.40	3.50	3.60	3.30	2.80	3.80	3.20	6.40
20	4.00	4.90	8.00	4.70	3.40	3.30	3.50	3.20	2.90	3.50	3.20	5.70
21	4.00	4.80	6.50	4.60	3.40	3.40	3.60	3.10	2.90	3.40	3.20	6.20
22	9.50	4.80	6.00	4.50	3.40	3.10	3.70	3.20	2.80	3.30	3.20	9.50
23	8.20	4.90	5.50	4.40	3.40	3.10	3.60	3.10	2.80	3.40	3.20	10.80
24	6.20	4.40	5.50	4.30	3.40	3.10	3.50	3.30	2.80	3.30	3.20	8.60
25	5.00	4.50	5.10	4.20	3.40	3.10	4.10	3.20	3.00	3.20	3.20	7.40
26	4.60	9.00	5.00	4.10	3.40	4.00	3.80	3.20	3.30	3.20	3.30	6.30
27	5.70	9.90	4.80	3.80	3.60	3.80	3.50	2.90	4.20	3.20	3.50	5.80
28	7.50	14.90	4.50	3.80	3.40	3.90	3.50	4.30	3.60	3.80	3.70	5.30
29	5.60	.....	4.25	4.00	3.30	3.90	3.60	4.70	3.50	5.70	3.80	4.80
30	5.00	.....	5.80	4.10	3.30	4.70	4.20	3.30	3.50	5.00	3.80	4.70
31	4.50	.....	6.00	.....	3.20	.....	4.20	2.90	.....	4.40	.....	4.70

Rating table for Juniata River at Newport, Pa., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.4	150	5.0	6,500	7.6	17,420	13.5	42,200
2.6	350	5.2	7,340	7.8	18,260	14.0	44,300
2.8	600	5.4	8,180	8.0	19,100	14.5	46,400
3.0	1,000	5.6	9,020	8.5	21,200	15.0	48,500
3.2	1,400	5.8	9,860	9.0	23,300	15.5	50,600
3.4	1,820	6.0	10,700	9.5	25,400	16.0	52,700
3.6	2,270	6.2	11,540	10.0	27,500	16.5	54,860
3.8	2,750	6.4	12,380	10.5	29,600	17.0	56,900
4.0	3,250	6.6	13,220	11.0	31,700	17.5	59,000
4.2	3,800	6.8	14,060	11.5	33,800	18.0	61,100
4.4	4,400	7.0	14,900	12.0	35,900		
4.6	5,020	7.2	15,740	12.5	38,000		
4.8	5,720	7.4	16,580	13.0	40,100		

Estimated monthly discharge of Juniata River at Newport, Pa.

[Drainage area, 3,476 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	25,400	2,040	7,096	2.04	2.35
February	48,080	2,270	8,486	2.44	2.54
March	91,760	3,800	23,604	6.79	7.83
April	63,200	2,750	13,753	3.96	4.42
May	3,250	1,400	2,194	.63	.73
June	5,360	1,200	1,929	.56	.62
July	13,640	2,040	4,801	1.38	1.59
August	5,360	800	2,409	.69	.80
September	3,800	600	1,092	.31	.35
October	12,380	1,400	3,743	1.08	1.25
November	3,250	1,400	1,867	.54	.60
December	30,860	2,270	10,094	2.90	3.34
The year	91,760	600	6,756	1.94	26.42

SUSQUEHANNA RIVER AT HARRISBURG, PA.

This station was established in 1890 by E. Mather, president of the Harrisburg water board.

Observations of the height of water since this time have been made

at the pump house of the waterworks located in the western part of the city of Harrisburg, Pa., this being about 55 miles below the junction of the north and west branches. A float is located in the pump well connected with the river, which indicates the height of water upon a painted scale. The datum is the low-water mark of 1804. Observations are made by the engineer, C. M. Nagle, each morning before starting the pumps. The record since 1890 has been furnished by E. Mather, president of the Harrisburg water board. Measurements of discharge are made from the open iron bridge on Second street. The initial point for soundings is the iron upright on the east end of the bridge. The stream is divided into two channels, with a large island between. The channel above and below the station is straight for about 2,500 feet, the banks high, and the current of moderate velocity. The first measurement was made on March 31, 1897, by E. G. Paul. During 1902 Mr. Paul made the following measurements:

April 17: Gage height, 5.40 feet; discharge, 60,534 second-feet.
September 15: Gage height, 1.10 feet; discharge, 6,982 second-feet.

Daily gage height, in feet, of Susquehanna River at Harrisburg, Pa.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	5.25	3.58	20.33	6.25	2.75	1.75	3.58	5.83	1.25	4.83	5.50	2.41
2	4.75	3.66	23.91	5.58	2.83	1.75	6.16	5.33	1.25	6.00	4.75	2.41
3	4.25	3.50	23.33	5.33	2.83	1.66	7.33	5.50	1.25	5.91	4.50	2.58
4	3.83	3.25	21.41	5.00	2.66	1.66	6.66	6.25	1.25	5.66	4.00	3.33
5	3.00	2.41	16.33	4.75	2.66	1.66	7.83	5.50	1.16	4.66	3.50	3.75
6	3.00	2.00	12.25	4.50	2.83	1.66	7.50	4.83	1.08	4.66	3.50	3.25
7	3.00	6.08	9.50	4.50	2.75	1.50	6.83	4.50	1.00	4.66	3.25	3.50
8	2.83	5.25	7.00	4.50	2.66	1.25	7.33	4.00	0.91	4.41	3.08	3.41
9	2.75	5.00	5.25	9.00	2.66	1.50	8.50	3.58	0.91	3.83	2.91	3.41
10	3.00	5.08	5.00	14.66	2.66	1.58	7.16	3.25	0.91	3.83	2.75	3.16
11	2.91	5.33	6.66	14.16	2.66	1.50	6.16	3.50	0.91	3.50	2.66	3.00
12	2.66	5.16	8.33	11.58	2.50	1.50	6.16	3.58	1.25	3.58	2.41	3.00
13	2.58	4.83	10.91	10.91	2.41	1.50	6.25	3.25	1.25	4.75	2.41	3.83
14	2.25	4.41	13.41	8.16	2.33	1.50	5.50	3.08	1.08	4.83	2.33	3.66
15	2.25	4.41	13.58	7.08	2.25	1.75	4.58	2.83	1.16	3.75	2.33	4.00
16	2.25	4.25	12.00	6.41	2.16	1.75	4.00	2.75	1.08	3.91	2.25	4.00
17	2.16	4.08	12.16	5.66	2.16	2.25	3.50	2.50	1.08	3.75	2.16	5.33
18	2.00	3.83	15.00	5.08	2.00	2.41	3.25	2.50	1.00	3.16	2.16	8.58
19	2.00	3.75	13.66	4.75	1.83	2.41	3.25	2.16	1.00	3.33	2.16	8.33
20	2.16	3.75	11.33	4.41	1.83	2.33	3.16	2.00	1.00	3.00	1.91	7.66
21	2.16	3.75	9.50	4.08	1.75	2.16	3.33	2.00	1.00	2.91	1.83	7.16
22	5.16	4.00	6.00	3.83	1.75	2.16	4.33	1.91	0.91	2.66	1.75	8.50
23	10.00	4.00	5.50	3.50	1.83	2.16	8.08	1.91	0.83	2.58	1.75	12.50
24	6.75	4.08	5.33	3.41	1.66	2.00	8.00	1.75	0.83	2.41	1.66	12.66
25	6.50	4.16	5.33	3.25	1.66	2.00	7.25	1.75	0.83	2.25	1.66	11.50
26	5.41	6.41	4.66	3.00	1.66	2.00	7.75	1.58	1.66	2.41	1.91	8.25
27	5.08	9.41	3.66	2.91	1.66	2.16	8.08	1.58	3.75	2.33	2.00	7.25
28	5.33	9.66	3.66	2.75	1.66	2.41	6.83	1.50	5.16	2.33	2.25	6.16
29	5.33	.....	4.41	2.75	1.66	2.41	5.83	1.41	4.33	3.66	2.33	5.58
30	4.33	.....	4.41	2.75	1.66	3.00	6.16	1.25	4.33	5.66	2.41	4.83
31	3.91	.....	5.33	.....	1.75	.....	6.16	1.25	.....	6.00	.....	4.58

Rating table for Susquehanna River at Harrisburg, Pa., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.0	2,500	3.4	27,925	6.8	83,970	13.5	203,900
.2	3,230	3.6	30,300	7.0	87,550	14.0	212,850
.4	4,020	3.8	32,800	7.2	91,130	14.5	221,800
.6	4,820	4.0	35,400	7.4	94,710	15.0	230,750
.8	5,720	4.2	38,100	7.6	98,290	15.5	239,700
1.0	6,880	4.4	41,100	7.8	101,870	16.0	248,650
1.2	8,150	4.6	44,590	8.0	105,450	16.5	257,600
1.4	9,450	4.8	48,170	8.5	114,400	17.0	266,550
1.6	10,750	5.0	51,750	9.0	123,350	17.5	275,500
1.8	12,300	5.2	55,330	9.5	132,300	18.0	284,450
2.0	13,900	5.4	58,910	10.0	141,250	18.5	293,400
2.2	15,500	5.6	62,490	10.5	150,200	19.0	302,350
2.4	17,300	5.8	66,070	11.0	159,150	19.5	311,300
2.6	19,300	6.0	69,650	11.5	168,100	20.0	320,250
2.8	21,300	6.2	73,230	12.0	177,050	20.5	329,200
3.0	23,400	6.4	76,810	12.5	186,000	21.0	338,150
3.2	25,625	6.6	80,390	13.0	194,950	21.5	347,100

Estimated monthly discharge of Susquehanna River at Harrisburg, Pa.

[Drainage area, 24,030 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	141,250	13,900	37,243	1.55	1.79
February	134,985	13,900	47,035	1.96	2.04
March	390,060	30,900	146,782	6.11	7.04
April	224,485	20,800	68,458	2.85	3.18
May	21,800	11,125	15,806	.66	.76
June	23,400	8,475	13,314	.55	.61
July	114,400	25,050	71,078	2.96	3.41
August	74,125	8,475	21,241	1.13	1.30
September	54,435	5,990	11,951	.50	.56
October	69,650	15,950	36,579	1.52	1.75
November	60,700	11,125	21,216	.88	.98
December	188,685	17,300	64,016	2.66	3.07
The year	390,060	5,990	46,727	1.94	26.49

PATAPSCO RIVER AT WOODSTOCK, MD.

This river rises in the north-central part of Maryland, flows in a southeasterly direction between Baltimore and Howard counties, and empties into Chesapeake Bay 13 miles below Baltimore. Its drainage basin is a hilly country largely under cultivation. A station was established at Woodstock August 6, 1896, by E. G. Paul. The drainage area is 251 square miles. Measurements are made from the county bridge on the road from Woodstock to Granite, Md., 1½ miles below the junction with the North Branch, as shown on the Ellicott atlas sheet. The scale is a board graduated to feet and tenths with small nails, and fastened to the floor timber of the bridge. The bench mark is a United States Geological Survey standard copper bolt, set in the face of the retaining wall of the entrance to the college grounds at the north end of the bridge. It is 22.06 feet above gage datum. The bridge was repaired on January 20–25, 1899, and the gage destroyed. A new gage was established on January 30, 1899, and referred to the same bench mark. The channel is rough and rocky. The banks are high and not subject to overflow. At a time of extreme high water the channel is liable to changes. The observer is David Donovan, a storekeeper at Woodstock, Md.

The following discharge measurement was made during 1902 by E. G. Paul:

September 4: Gage height 3.70 feet; discharge, 153 second-feet.

Daily gage height, in feet, of Patapsco River at Woodstock, Md.

Day. 1902.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.00	4.90	5.35	4.65	4.50	3.85	4.30	3.85	3.65	6.50	3.85	4.85
2	4.00	4.95	5.75	4.60	4.45	3.75	4.05	3.80	3.60	4.95	3.75	5.20
3	4.00	4.70	5.50	4.55	4.45	3.75	3.95	3.75	3.65	4.40	3.85	6.45
4	4.15	4.65	5.15	4.45	4.45	3.80	3.95	4.10	3.75	4.10	3.85	4.50
5	4.15	4.55	5.15	4.50	4.35	3.70	3.85	3.80	3.45	4.05	3.75	4.45
6	4.10	4.45	5.10	4.55	4.30	3.70	3.80	4.70	3.50	3.95	3.85	4.45
7	4.20	4.35	5.00	4.60	4.30	3.65	3.70	4.85	3.50	3.85	3.85	4.45
8	4.25	4.30	4.95	7.20	4.30	4.85	3.65	4.80	3.50	3.85	8.75	4.45
9	4.30	4.35	5.15	5.50	4.30	4.05	3.65	4.60	4.85	3.75	3.80	4.35
10	4.20	4.35	5.30	5.15	4.30	4.00	3.45	4.30	4.05	3.75	3.90	4.45
11	4.20	4.25	5.25	4.95	4.25	3.90	3.70	4.05	3.60	3.85	3.80	4.35
12	4.20	4.25	5.20	4.85	4.30	3.85	3.60	3.75	3.45	3.85	3.80	4.45
13	4.15	4.35	5.40	4.85	4.30	3.85	3.70	3.85	3.45	3.85	3.80	4.45
14	4.00	4.70	5.20	4.80	4.30	3.90	3.80	3.70	3.50	3.90	3.80	4.45
15	4.15	4.55	4.80	4.75	4.25	3.80	3.80	3.70	3.45	3.80	3.75	4.45
16	4.10	4.60	5.10	4.75	4.25	4.15	3.70	3.75	3.25	3.75	3.70	4.35
17	4.10	4.55	4.95	4.65	4.20	4.15	3.60	3.60	3.45	3.85	3.80	4.55
18	4.10	4.60	4.90	4.60	4.15	4.05	3.80	3.60	3.45	3.85	3.80	4.45
19	4.10	4.75	4.75	4.60	4.10	4.10	3.65	3.70	3.40	3.90	3.80	4.50
20	4.05	4.55	4.70	4.55	4.10	4.00	3.65	3.65	3.50	3.80	3.75	4.35
21	4.50	5.70	4.75	4.50	4.05	4.50	3.70	3.70	3.45	3.75	3.75	4.45
22	6.50	6.50	4.55	4.45	4.10	4.20	3.80	3.70	3.55	3.75	3.80	4.45
23	4.40	5.70	4.60	4.45	4.10	4.05	3.85	3.70	3.55	3.85	3.85	4.45
24	4.25	4.95	4.55	4.45	4.05	3.90	3.85	3.60	3.50	3.70	3.90	4.45
25	4.20	8.60	4.50	4.40	4.00	4.25	3.70	3.65	3.90	3.75	4.70	4.45
26	4.85	5.75	4.45	4.40	3.95	5.45	3.80	3.65	5.50	3.75	4.70	4.55
27	5.75	13.50	4.55	4.45	3.90	4.70	3.65	3.60	4.50	3.80	4.60	4.55
28	4.90	10.40	4.55	4.40	4.10	4.35	3.70	3.80	3.85	3.75	4.00	4.55
29	4.40		4.75	4.40	4.00	3.95	3.75	3.80	3.65	3.85	4.00	4.55
30	4.20		4.60	4.95	3.95	4.70	3.95	3.70	3.60	3.85	3.95	4.55
31	4.05		4.55		3.90		4.25	3.70		3.80		4.55

Rating table for Patapsco River at Woodstock, Md., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.0	50	4.8	830	6.6	2,615	9.0	5,075
3.2	83	5.0	1,000	6.8	2,820	9.5	5,588
3.4	122	5.2	1,200	7.0	3,025	10.0	6,100
3.6	173	5.4	1,400	7.2	3,229	10.5	6,612
3.8	235	5.6	1,600	7.4	3,435	11.0	7,125
4.0	310	5.8	1,800	7.6	3,640	11.5	7,638
4.2	400	6.0	2,000	7.8	3,844	12.0	8,150
4.4	520	6.2	2,205	8.0	4,050		
4.6	670	6.4	2,410	8.5	4,562		

Estimated monthly discharge of Patapsco River at Woodstock, Md.

[Drainage area, 251 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	2,307	235	432	1.72	1.98
February	9,483	332	1,348	5.38	5.60
March	1,550	425	797	3.18	3.67
April	3,025	400	649	2.58	2.88
May	450	200	313	1.24	1.43
June	1,250	135	305	1.22	1.36
July	355	91	174	.69	.80
August	710	122	225	.90	1.04
September	1,500	111	245	.98	1.09
October	2,512	200	351	1.40	1.61
November	750	200	292	1.16	1.29
December	1,200	425	651	2.59	2.99
The year	9,483	91	482	1.92	25.74

POTOMAC RIVER DRAINAGE BASIN.

Potomac River is formed by the junction of the North and South branches, about 15 miles below Cumberland, Md. Regular gaging stations have been maintained on the North Branch at Piedmont, W. Va., on the South Branch near Springfield, W. Va., on Antietam Creek near Sharpsburg, Md., on the North Branch of Shenandoah River near Riverton, Va., on the South Branch of Shenandoah River near Front Royal, Va., on Shenandoah River at Millville, W. Va., on Potomac River at Point of Rocks, Md., and on Monocacy River near Frederick, Md.

NORTH BRANCH OF POTOMAC RIVER AT PIEDMONT, W. VA.

This stream rises in the western part of West Virginia and flows in a northeasterly direction, forming the boundary between Maryland and West Virginia. At a point about 15 miles below Cumberland it is joined by the South Branch, forming the Potomac River. The drainage area is mapped on Piedmont, St. George, Accident, Grantsville, and Frostburg atlas sheets. Systematic measurements of discharge have been made at Piedmont, W. Va. This station, established June 27, 1899, by E. G. Paul, is located at the iron highway bridge connecting Luke, Md., with Piedmont, W. Va. The equipment

consists of a standard chain-and-weight gage, referred to a horizontal scale board graduated to feet and tenths, inclosed in lock-box secured by bolts to the hand rail on the lower side of the bridge. The length of the chain from the zero to the extreme end of the weight is 38.87 feet. The channel is straight for an eighth of a mile above and below the station. The current is swift and unobstructed. The right bank is high and rocky, but the left bank is low and liable to overflow. The bed of the stream is rocky and permanent in section. The observer is Charles W. Beck, a bookkeeper at Piedmont, W. Va.

The following discharge measurement were made during 1902, by E. G. Paul:

August 19: Gage height, 2.14 feet; discharge, 50 second-feet.

Daily gage height, in feet, of North Branch of Potomac River at Piedmont, W. Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902												
1	4.45	3.80	8.05	4.90	3.55	3.30	4.75	2.85	1.90	3.30	2.60	4.00
2	4.00	3.60	7.10	4.65	3.40	3.20	3.80	2.70	1.90	3.35	2.50	3.75
3	4.30	3.50	6.20	4.40	3.70	3.10	3.35	2.60	1.90	2.85	2.50	5.25
4	3.80	3.20	5.40	4.70	3.70	3.00	3.20	2.50	2.00	2.70	2.40	4.55
5	3.55	3.40	4.95	5.05	3.55	3.00	3.10	2.50	2.20	2.90	2.40	4.30
6	3.60	3.50	4.50	5.95	3.45	2.85	2.95	2.50	2.35	2.90	2.40	3.90
7	3.60	3.50	4.20	6.20	3.50	2.80	2.80	2.50	2.20	2.85	2.40	3.80
8	3.60	3.40	4.20	6.45	3.40	2.85	3.05	2.40	2.10	2.60	2.50	3.75
9	3.45	3.30	4.65	5.85	3.30	2.95	3.20	2.40	2.00	2.50	2.50	3.50
10	3.45	3.20	4.95	5.70	3.20	2.85	2.95	2.45	2.00	2.40	2.50	3.45
11	3.40	3.15	5.65	6.20	3.40	2.70	3.20	2.50	2.00	2.40	2.50	5.65
12	3.30	3.15	6.85	7.05	3.25	2.70	3.05	2.40	2.00	3.25	2.50	6.45
13	3.10	3.10	8.10	6.25	3.20	2.60	2.80	2.35	1.90	3.70	2.50	6.00
14	3.20	3.05	6.60	5.80	3.15	3.10	2.70	2.30	1.90	3.35	2.50	5.80
15	3.20	3.10	5.85	5.55	3.10	2.90	2.60	2.25	1.90	3.15	2.40	5.00
16	3.10	3.00	5.85	5.25	3.10	2.80	2.50	2.20	1.90	2.95	2.40	7.60
17	3.05	3.00	6.75	5.10	3.00	2.70	2.45	2.20	1.90	2.70	2.45	6.45
18	2.90	3.00	5.65	4.95	3.00	2.60	2.40	2.20	1.90	2.70	2.50	5.45
19	3.00	3.00	4.95	4.55	2.90	2.50	2.40	2.15	1.90	2.70	2.50	4.90
20	2.90	2.85	4.60	4.40	3.45	2.50	2.55	2.10	1.90	2.60	2.50	4.70
21	2.90	2.80	4.45	4.25	3.75	2.60	2.60	2.15	1.90	2.50	9.50	5.00
22	2.90	2.80	4.50	4.15	3.45	2.90	2.50	2.50	2.00	2.40	2.50	5.40
23	2.90	3.00	4.50	4.25	3.40	2.70	2.40	2.40	2.00	2.40	2.50	5.15
24	3.00	3.05	4.50	4.15	3.30	2.50	2.40	2.30	2.00	2.40	2.50	4.70
25	3.00	3.35	4.45	3.80	3.30	2.40	2.30	2.20	2.00	2.40	2.75	4.50
26	3.30	6.55	4.25	3.70	3.60	2.80	2.30	2.10	2.20	2.40	5.45	4.10
27	5.73	6.05	4.15	3.65	4.10	3.00	2.30	2.10	2.20	2.40	4.50	3.80
28	5.00	10.50	4.20	3.55	4.00	2.70	2.30	2.00	2.65	(a)	3.85	3.70
29	4.65	.....	5.50	3.60	3.80	2.60	2.30	1.90	2.40	(a)	3.60	3.55
30	4.10	.....	5.30	3.70	3.60	2.75	2.20	1.90	2.45	2.80	3.50	4.00
31	4.05	.....	5.25	.....	3.35	.....	2.30	1.90	.....	2.70	.....	3.70

(a) Gage chain broken.

Rating table for North Branch Potomac River at Piedmont, W. Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.8	34	3.6	640	5.4	2,040	7.2	3,480
2.0	77	3.8	775	5.6	2,200	7.4	3,640
2.2	124	4.0	920	5.8	2,360	7.6	3,800
2.4	175	4.2	1,080	6.0	2,520	7.8	3,960
2.6	230	4.4	1,240	6.2	2,680	8.0	4,120
2.8	289	4.6	1,400	6.4	2,840	8.5	4,520
3.0	352	4.8	1,560	6.6	3,000	9.0	4,920
3.2	430	5.0	1,720	6.8	3,160		
3.4	525	5.2	1,880	7.0	3,320		

Estimated monthly discharge of North Branch Potomac River at Piedmont, W. Va.

[Drainage area, 409 square miles.]

Month.	Discharge in second-feet			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	2,304	320	688	1.68	1.94
February	6,120	289	809	1.98	2.06
March	4,160	1,040	2,008	4.91	5.66
April	3,360	610	1,666	4.07	4.54
May	1,000	320	553	1.35	1.56
June	475	175	292	.71	.79
July	1,520	124	313	.77	.89
August	305	55	153	.37	.43
September	245	55	91	.22	.25
October	705	175	288	.70	.81
November	2,080	175	347	.85	.95
December	3,800	552	1,516	3.71	4.28
The year	6,120	55	727	1.78	24.16

SOUTH BRANCH OF POTOMAC RIVER AT SPRINGFIELD, W. VA.

This stream rises in Highland County, W. Va., and flows in a northeasterly direction, joining the North Branch of Potomac River about 15 miles below Cumberland, Md., forming Potomac River. The drainage area of the South Branch consists of long, narrow mountain valleys, sparsely settled and little cultivated, being for the greater part covered with timber. The region being free from manufacturing industries and mining operations, no pollution of the waters occurs. A gaging station was established at the railroad bridge, 2 miles south of Springfield, W. Va., in April, 1894, by Cyrus C. Babb, but was discontinued in 1896 for want of an observer. The present station, established June 26, 1899, by E. G. Paul, is located on the iron highway bridge, one-fourth of a mile from Graces Station and 1 mile from Springfield. The wire gage is 39.4 feet from the zero to the extreme end of the weight and is referred to a scale graduated to feet and tenths on the guard rail on the upper side of the bridge 80 feet from the abutment on the left bank. The channel of the stream at this point is curved and the current too sluggish to make satisfactory discharge measurements, and they are therefore made from the railroad bridge over the stream 1 mile above. The observer is John E. Grace, of Springfield, W. Va.

On February 2, 1902, the bridge and gage were carried away by the ice, and the station was discontinued.

ANTIETAM CREEK NEAR SHARPSBURG, MD.

This stream rises in the western part of Maryland and flows in a southerly direction, entering the Potomac 10 miles above Harpers Ferry. Its drainage area is mostly of a hilly character and largely cultivated. A station was established at Myers Mill, 1 mile east of Sharpsburg, Md., on the road to Keedysville, Md., on June 24, 1897, by Arthur P. Davis. The measurements are made from a three-fourths inch iron cable with 85-foot span supported by large trees on either side of the stream. The gage is a post driven into the gravel of the stream bed and bolted to an overhanging tree. The initial point for soundings is on the left bank. The channel both above and below the station is straight for 300 feet. The right bank is low and liable to overflow. The left bank is high and rocky. The current is of moderate velocity and the flow unobstructed.

During 1902 the following measurement was made by E. G. Paul:

September 4: Gage height, 1.7 feet; discharge, 126 second-feet.

Daily gage height, in feet, of Antietam Creek near Sharpsburg, Md.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	2.90	2.40	7.00	2.90	2.60	2.10	2.20	2.60	1.70	1.70	1.60	1.80
2	2.70	2.40	5.05	2.90	2.50	2.20	2.10	2.40	1.60	1.80	1.70	2.40
3	2.70	2.60	4.60	2.80	2.50	2.20	2.10	1.80	1.60	1.60	1.70	4.05
4	2.50	2.50	3.90	2.80	2.50	2.20	2.00	1.80	1.70	1.60	1.60	3.60
5	2.40	2.40	4.00	2.80	2.50	2.10	2.00	1.90	1.60	2.30	1.60	2.60
6	2.40	2.30	3.60	2.70	2.40	2.10	1.90	1.90	1.50	2.10	1.70	2.50
7	2.30	2.20	3.50	2.90	2.40	2.10	2.30	1.90	1.50	1.90	1.70	2.30
8	2.30	2.10	3.50	3.90	2.40	2.00	2.70	1.70	1.40	1.70	1.70	2.10
9	2.30	2.10	3.70	6.45	2.30	2.00	2.70	1.70	1.60	1.70	1.70	1.80
10	2.30	2.30	4.20	4.45	2.30	2.00	3.50	1.60	1.60	1.60	1.70	1.90
11	2.30	2.40	4.40	3.90	2.40	2.00	2.00	1.80	1.70	1.80	1.60	2.00
12	2.20	2.20	4.40	3.60	2.30	2.10	2.00	1.80	1.60	1.80	1.60	2.40
13	2.20	2.30	4.80	3.50	2.30	2.20	1.80	1.70	1.70	2.10	1.60	2.80
14	2.20	2.20	4.70	3.30	2.30	2.20	1.80	1.60	1.50	1.90	1.50	2.70
15	2.10	2.20	3.90	3.20	2.30	2.20	1.80	1.60	1.40	1.80	1.50	2.70
16	2.10	2.00	3.70	3.10	2.20	2.30	1.70	1.60	1.60	1.70	1.60	2.80
17	2.10	2.20	5.10	3.10	2.20	2.40	1.70	1.40	1.60	1.70	1.70	4.10
18	2.10	2.10	4.20	3.00	2.20	2.40	1.70	1.40	1.60	1.70	1.70	3.80
19	2.10	1.90	3.70	2.90	2.90	2.20	2.40	1.50	1.60	1.60	1.60	3.80
20	2.10	2.00	3.50	2.90	2.40	2.30	2.70	1.50	1.50	1.80	1.60	3.50
21	3.80	3.15	3.60	2.80	2.30	2.30	1.80	2.00	1.50	1.70	1.60	3.60
22	4.25	4.70	3.40	2.80	2.30	2.00	1.80	2.00	1.40	1.70	1.50	3.80
23	2.70	3.60	3.40	2.80	2.20	2.00	1.70	1.90	1.50	1.80	1.50	3.60
24	2.40	3.50	3.40	2.70	2.20	2.00	1.70	1.70	1.70	1.70	1.50	3.10
25	2.40	6.20	3.10	2.70	2.40	1.90	1.90	1.50	1.70	1.70	1.60	3.10
26	2.30	10.00	3.00	2.60	2.60	2.20	1.80	1.50	1.80	1.70	1.80	2.80
27	4.25	5.15	3.00	2.60	2.20	2.20	1.80	1.50	2.30	1.70	2.20	2.90
28	3.20	7.45	2.90	2.60	2.30	2.20	1.70	1.60	1.60	1.70	2.10	3.00
29	2.70	.....	3.40	2.60	2.20	2.20	1.70	1.50	1.60	2.10	1.80	3.20
30	2.60	.....	3.10	2.70	2.20	2.40	1.90	1.50	1.50	1.80	2.30	3.10
31	2.40	.....	3.00	.....	2.20	.....	2.55	.....	.....	1.60	.....	3.10

Rating table for Antietam Creek near Sharpsburg, Md., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.2	38	2.6	416	4.0	1,215	5.4	2,013
1.4	60	2.8	485	4.2	1,329	5.6	2,127
1.6	95	3.0	560	4.4	1,443	5.8	2,241
1.8	154	3.2	665	4.6	1,557	6.0	2,355
2.0	217	3.4	775	4.8	1,671		
2.2	281	3.6	887	5.0	1,785		
2.4	348	3.8	1,001	5.2	1,899		

Estimated monthly discharge of Antietam Creek near Sharpsburg, Md.

[Drainage area, 293 square miles.]

Month	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	1,357	249	434	1.48	1.71
February	4,635	185	787	2.68	2.79
March	2,925	520	1,094	3.73	4.30
April	2,612	416	668	2.28	2.54
May	520	281	333	1.14	1.31
June	348	185	268	.92	1.03
July	830	123	238	.81	.93
August	416	60	139	.47	.54
September	314	60	102	.35	.39
October	314	95	148	.51	.59
November	314	75	123	.42	.47
December	1,272	154	591	2.02	2.33
The year	4,635	60	410	1.40	18.93

NORTH BRANCH OF SHENANDOAH RIVER AT RIVERTON, VA.

This stream rises in Rockingham County, Va., and flows in a northeasterly direction, joining the South Branch of the Shenandoah at Riverton, Va. The station was established at Riverton by A. P. Davis, June 26, 1899. Measurements were made from an iron-wire cable about 260 feet in span stretched across the river on timber supports 2 miles northwest of Riverton. The station is most easily reached by a private conveyance from Front Royal, Va. The gage is a vertical timber, graduated to feet and tenths, bolted to a large sycamore tree on the right bank of the stream. The initial point of soundings is on the right bank. The channel is straight above and below the station for about 600 feet. The banks are low and liable to overflow in time of high water. Bed of stream is rocky and constant. The observer is L. W. Burke, a farmer, Riverton, Va. Two observations of river height are taken daily. On September 10, 1900, the gage was moved to the left bank of the river and its datum changed 1 foot, causing all readings to be increased by 1 foot.

The gage at this station washed out in the flood of February 22, 1902, and the station was temporarily abandoned until August 17, 1902, when it was reestablished by Mr. Paul, the zero of the new gage being at the same elevation as the zero of the former gage.

The following discharge measurement was made during 1902 by Mr. Paul:

August 16: Gage height, 4.2 feet; discharge, 256 second-feet.

Daily gage height, in feet, of North Branch of Shenandoah River near Riverton, Va.

Day.	Jan.	Feb.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.							
1	7.05	4.90	(a)	4.05	4.30	4.10	5.45
2	6.20	7.88	.....	4.05	4.20	4.15	5.75
3	5.75	4.80	.....	4.10	4.20	4.10	5.85
4	5.40	5.20	.....	4.35	4.20	4.10	5.90
5	5.00	5.50	.....	4.10	4.20	4.15	5.80
6	4.90	5.50	.....	4.05	4.20	4.20	5.80
7	4.85	5.50	.....	4.00	4.30	4.20	5.55
8	4.80	5.50	.....	4.05	4.20	4.10	5.50
9	4.70	5.50	.....	4.05	4.15	4.10	5.30
10	4.68	5.50	.....	4.10	4.10	4.10	5.15
11	4.55	5.50	.....	4.10	4.15	4.00	5.05
12	4.50	5.50	.....	4.10	4.25	4.10	5.35
13	4.60	5.50	.....	4.05	4.30	4.10	5.25
14	4.55	5.50	.....	4.00	4.60	4.10	6.60
15	4.60	5.50	.....	4.00	4.35	4.10	6.30
16	4.55	5.50	.....	3.90	4.30	4.10	5.85
17	4.48	5.50	4.20	4.00	4.25	4.10	8.15
18	4.35	5.50	4.10	4.00	4.20	4.10	7.65
19	4.28	5.50	4.20	4.00	4.20	4.20	7.10
20	4.20	5.50	4.20	4.00	4.15	4.20	5.75
21	4.30	5.50	4.20	4.00	4.10	4.20	5.50
22	5.40	5.50	4.20	4.05	4.10	4.20	5.45
23	5.15	(a)	4.20	4.05	4.10	4.20	5.25
24	4.75	.....	4.20	4.10	4.10	4.20	5.20
25	4.60	.....	4.20	4.10	4.10	4.35	5.00
26	4.75	.....	4.20	4.10	4.10	5.00	4.95
27	5.00	.....	4.10	4.10	4.10	4.95	4.85
28	6.15	.....	4.10	4.05	4.20	5.20	4.90
29	5.50	.....	4.15	4.15	4.20	5.10	5.00
30	5.05	.....	4.10	4.20	4.20	5.00	4.85
31	4.95	.....	4.10	.....	4.20	.....	4.70

[a] Gage washed out Feb. 22, 1902; reestablished Aug. 17, 1902.

SOUTH BRANCH OF SHENANDOAH RIVER AT FRONT ROYAL, VA.

This stream rises in Augusta County, Va., and flows in a northeasterly direction, joining the North Branch of the Shenandoah at Riverton to form Shenandoah River. A station was established on the South Branch by A. P. Davis, June 26, 1899. The measurements of flow are made from an iron wire cable, 300 feet in span, stretched across the stream 3 miles southwest of Front Royal, Va. The gage is a vertical timber divided into feet and tenths and bolted to the trunk of a tree on the left bank of the stream. The initial point for sounding is on the left bank. The channel is straight 600 feet above and below the station, and the current sluggish. The left

bank is low and liable to overflow. The bed of the stream is rocky in part, with patches of sand, somewhat shifting. The observer is Miss Brentie Johnson, Front Royal, Va.

The following discharge measurement was made during 1902 by Mr. Paul.

August 15: Gage height, 4.2 feet; discharge, 527 second-feet.

Daily gage height, in feet, of South Branch of Shenandoah River at Front Royal, Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	9.50	6.10	23.50	6.55	5.40	4.90	4.60	4.40	4.00	5.00	4.25	5.80
2	9.15	5.25	13.00	6.45	5.35	4.80	4.55	4.40	3.95	4.30	4.25	6.30
3	8.30	6.70	9.90	6.25	5.30	4.75	4.50	4.60	3.90	6.00	4.40	7.00
4	7.70	6.05	9.50	6.15	6.50	4.70	4.45	4.60	3.90	5.10	4.50	7.25
5	8.40	6.60	8.90	5.95	6.35	4.60	4.40	4.60	3.85	5.00	4.30	7.85
6	8.15	5.90	8.40	7.40	6.15	4.55	4.50	4.50	3.80	4.30	4.30	7.65
7	8.00	5.70	7.95	7.25	5.85	4.50	4.45	4.50	3.80	4.30	4.20	6.85
8	7.75	6.90	7.50	7.70	5.65	4.90	4.40	4.40	4.00	4.20	4.20	6.55
9	7.55	5.90	9.10	9.10	5.50	4.90	4.40	4.30	4.20	4.10	4.20	6.40
10	7.30	5.70	10.50	10.50	5.35	4.85	4.30	4.40	4.10	4.55	4.20	6.15
11	6.55	5.90	13.25	10.50	5.50	4.80	4.30	4.35	4.10	4.90	4.25	5.95
12	6.00	6.10	11.85	9.60	5.45	4.80	4.20	4.30	4.00	4.90	4.35	5.75
13	5.90	6.10	10.10	6.90	5.40	4.70	4.60	4.30	4.00	5.50	4.35	6.30
14	5.80	5.75	8.50	6.75	5.40	4.60	4.60	4.20	4.00	5.65	4.25	6.35
15	5.75	5.45	8.10	6.60	5.30	4.80	4.50	4.20	4.00	5.35	4.10	6.30
16	5.65	5.50	8.80	6.45	5.30	4.80	4.50	4.15	4.00	5.00	4.25	6.55
17	5.55	5.40	8.45	6.25	5.30	4.70	4.45	4.25	4.00	4.65	4.60	6.85
18	5.50	5.35	8.20	6.15	5.40	4.65	4.40	4.30	4.10	4.45	4.50	8.10
19	5.50	5.30	7.80	6.00	5.40	4.60	4.35	4.35	3.90	4.40	4.50	7.60
20	5.45	5.25	7.35	6.20	5.40	4.55	4.50	4.35	3.85	4.40	4.45	6.60
21	5.35	5.20	6.75	6.15	5.30	4.45	4.50	4.30	3.80	4.35	4.40	6.50
22	6.30	7.45	6.45	6.00	5.25	4.80	4.40	4.20	3.80	4.30	4.35	6.40
23	5.75	6.20	7.90	5.80	5.20	4.75	4.40	4.10	4.00	4.30	4.30	6.35
24	5.30	7.35	7.90	5.70	5.10	4.70	4.30	4.20	4.10	4.30	4.35	6.25
25	5.30	11.00	7.80	5.55	5.20	4.60	4.20	4.15	4.15	4.35	4.40	5.90
26	5.25	15.00	7.70	5.50	5.10	4.50	4.20	4.10	4.20	4.35	4.50	5.65
27	6.40	20.00	7.60	5.60	5.10	4.50	5.50	4.10	4.20	4.40	5.75	5.55
28	7.30	14.50	7.45	5.55	5.00	4.40	5.35	4.00	4.20	4.50	6.25	5.50
29	8.55	.....	6.55	5.45	4.90	4.70	5.05	4.00	6.00	4.35	5.75	5.50
30	6.70	.....	6.70	5.40	4.80	4.70	4.75	4.00	5.55	4.30	5.20	5.40
31	5.45	.....	6.65	.....	4.75	.....	4.55	4.00	.....	4.30	.....	5.30

Rating table for South Branch of Shenandoah River at Front Royal, Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.0	360	6.4	3,100	10.0	9,580	16.0	20,380
4.2	470	6.6	3,460	10.5	10,480	16.5	21,280
4.4	605	6.8	3,820	11.0	11,380	17.0	22,180
4.6	750	7.0	4,180	11.5	12,280	17.5	23,080
4.8	915	7.2	4,540	12.0	13,180	18.0	23,980
5.0	1,100	7.4	4,900	12.5	14,080	18.5	24,880
5.2	1,300	7.6	5,260	13.0	14,980	19.0	25,780
5.4	1,520	7.8	5,620	13.5	15,880	19.5	26,680
5.6	1,760	8.0	5,980	14.0	16,780	20.0	27,580
5.8	2,050	8.5	6,880	14.5	17,680		
6.0	2,380	9.0	7,780	15.0	18,580		
6.2	2,740	9.5	8,680	15.5	19,480		

Estimated monthly discharge of South Branch Shenandoah River at Front Royal, Va.

[Drainage area, 1,569 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	8,680	1,355	3,676	2.34	2.70
February	27,580	1,300	4,751	3.03	3.16
March	33,880	3,190	7,844	5.00	5.76
April	10,480	1,520	3,698	2.36	2.63
May	3,280	872	1,558	.99	1.14
June	1,005	605	822	.52	.58
July	1,640	470	709	.45	.52
August	750	360	527	.34	.39
September	2,380	275	475	.30	.33
October	2,380	410	835	.53	.61
November	2,830	470	756	.48	.54
December	6,160	1,410	3,140	2.00	2.31
The year	33,880	275	2,399	1.53	20.67

SHENANDOAH RIVER AT MILLVILLE, W. VA.

This river, formed by the junction of the North Fork and the South Fork at Riverton, Va., flows in a northeasterly direction into West Virginia, where it empties into the Potomac at Harpers Ferry.

Observations of the height of Potomac River at the junction of Shenandoah River have been made by the Weather Bureau at Harpers Ferry, W. Va. The gage is on the west face and north end of the second abutment of the old railroad bridge from the West Virginia side of the river. It is of Portland cement, 15 inches wide, plastered on the face of the pier extending to 32 feet, and continued on the iron upright of the bridge to 36 feet. The top surface of the 6-by-6-inch-square capstone corresponds to the 32-foot mark on the gage. The elevation is 235.5 feet above mean sea level.

A station was established at Millville, W. Va., April 15, 1895, on Shenandoah River, 4 miles above its mouth. A vertical gage was placed in the river and fastened to a tree, a deep notch being cut in the tree opposite the 8-foot mark. The gage is referred to a bench mark consisting of a copper bolt driven in the foot of a large sycamore tree on the left bank of the river 150 feet below the gage rod, at an elevation of 6.78 feet above the zero mark on the gage. Measurements are made from a cable stretched across the river. The old cable was carried away by the flood of 1896, and a new three-fourths inch galvanized iron-wire cable was put in place on June 23, 1897. The cable, about 500 feet in length, is supported on either bank by a large sycamore tree, and is securely anchored on both sides. The channel is straight, current swift and unobstructed. The banks are low and subject to overflow. The observer is W. R. Nicewarner.

The following discharge measurement was made during 1902 by E. G. Paul.

August 17: Gage height, 0.7 feet; discharge, 811 second-feet.

Daily gage height, in feet, of Shenandoah River at Millville, W. Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	7.40	3.10	14.25	3.75	2.20	1.45	1.30	0.90	0.65	0.90	0.80	2.70
2	5.30	2.85	9.00	3.40	2.15	1.40	1.20	1.50	.65	.85	.80	2.45
3	4.50	3.00	7.20	3.20	2.20	1.35	1.15	1.90	.60	.80	.80	3.10
4	4.00	3.00	5.70	3.10	2.25	1.30	1.10	1.70	.60	.70	.80	3.20
5	3.50	2.80	5.00	2.90	2.10	1.30	1.05	1.30	.60	.90	.75	4.50
6	3.25	2.50	4.50	2.80	2.05	1.30	1.10	1.20	.65	1.00	.75	3.40
7	3.00	2.80	4.20	2.60	2.00	1.40	1.10	1.10	.60	.80	.70	3.70
8	2.85	2.70	4.20	2.80	4.00	1.25	1.05	1.05	.55	.75	.70	3.20
9	2.75	[a]2.20	5.50	6.00	2.70	1.20	1.05	1.00	.60	1.10	.70	2.90
10	2.60	[a]2.20	7.80	6.90	2.40	1.20	1.00	.90	.55	.90	.65	2.65
11	2.50	[a]2.10	8.00	7.20	2.10	1.15	.95	.80	.55	1.00	.65	2.60
12	2.40	[a]2.20	7.40	6.20	2.00	1.10	.90	.80	.55	1.00	.60	2.35
13	2.25	[a]2.10	7.20	5.60	2.00	1.10	.90	.80	.50	1.20	.65	2.80
14	2.40	[a]2.00	7.00	5.00	1.95	1.00	.90	.80	.50	1.75	.70	3.40
15	2.20	[a]2.10	6.00	4.40	1.90	1.10	.80	.80	.55	1.55	.65	3.40
16	2.10	1.50	5.00	3.90	1.80	1.20	.80	.75	.55	1.30	.60	3.40
17	2.00	1.90	5.20	3.60	1.70	1.20	.80	.70	.50	1.15	.65	4.40
18	1.90	2.00	5.90	3.40	1.70	1.10	.80	.70	.50	1.00	.80	4.30
19	1.85	2.00	5.00	3.20	1.75	1.60	.75	.85	.50	.95	.80	4.00
20	1.80	1.70	4.40	3.00	1.80	1.40	.75	.80	.55	.90	.90	3.50
21	1.90	1.00	4.10	2.80	1.75	1.20	.80	.80	.60	.85	.80	3.10
22	3.20	2.40	3.80	2.70	1.65	1.20	.80	.80	.60	.80	.90	2.90
23	3.40	4.05	3.50	2.60	1.60	1.10	.80	.80	.60	.75	1.00	2.70
24	2.90	3.90	3.20	2.50	1.60	1.10	.75	.80	.55	.70	1.00	2.50
25	2.50	4.70	3.10	2.40	1.60	1.20	.75	.80	.55	.70	1.00	2.30
26	2.30	([b])	2.95	2.30	1.60	1.20	.80	.75	.60	.70	1.20	2.20
27	2.50	([b])	2.80	2.25	2.20	1.15	1.00	.70	.60	.65	2.00	2.10
28	3.60	11.00	2.75	2.20	1.75	1.10	.90	.70	.60	.90	2.50	2.10
29	4.40	.....	3.60	2.20	1.60	1.30	1.30	.70	.65	.85	2.40	2.10
30	3.60	.....	3.80	2.20	1.55	1.40	1.30	.65	1.00	.80	2.10	1.90
31	3.30	.....	3.90	.....	1.50	.....	1.40	.65	.....	.80	.....	1.80

[a] Backed by ice.

[b] Flood; no measurement.

Rating table for Shenandoah River at Millville, W. Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.4	540	2.8	4,160	5.2	10,960	7.6	18,640
.6	740	3.0	4,600	5.4	11,600	7.8	19,280
.8	940	3.2	5,060	5.6	12,240	8.0	19,920
1.0	1,140	3.4	5,540	5.8	12,880	8.5	21,520
1.2	1,370	3.6	6,050	6.0	13,520	9.0	23,120
1.4	1,650	3.8	6,600	6.2	14,160	9.5	24,720
1.6	1,950	4.0	7,190	6.4	14,800	10.0	26,320
1.8	2,260	4.2	7,790	6.6	15,440	10.5	27,920
2.0	2,600	4.4	8,410	6.8	16,080	11.0	29,520
2.2	2,960	4.6	9,040	7.0	16,720		
2.4	3,340	4.8	9,680	7.2	17,360		
2.6	3,740	5.0	10,320	7.4	18,000		

Estimated monthly discharge of Shenandoah River at Millville, W. Va.

[Drainage area, 2,995 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	18,000	2,260	4,998	1.67	1.93
February	29,520	1,140	6,503	2.17	2.26
March	39,920	4,055	11,551	3.86	4.45
April	17,360	2,960	6,423	2.14	2.39
May	7,190	1,800	2,613	.87	1.00
June	1,725	1,140	1,425	.48	.54
July	1,650	890	1,122	.37	.43
August	2,430	790	1,089	.36	.42
September	1,140	640	728	.24	.27
October	2,180	790	1,095	.37	.43
November	3,540	740	1,209	.40	.45
December	8,720	2,260	4,653	1.55	1.79
The year	39,920	640	3,618	1.21	16.36

POTOMAC RIVER AT POINT OF ROCKS, MD.

This station was established February 17, 1895, at the toll bridge over the Potomac River at Point of Rocks. It has been described and results of measurements have been given in the various annual reports and in the Water-Supply and Irrigation Papers containing reports of the operations at river stations. More or less difficulty has been experienced with the wire gage, due to its stretching, and no record of this lengthening has been noted. A thorough study of the changes of the gage have been made in this office, based on measurements and on a study of the average depth of soundings, with the result that it has been found necessary to modify the gage heights in order to refer them to a common datum. This has also necessitated a revision of the rating table. In some cases it has been impossible to reduce the measurements to the known datum, and it has therefore been thought best to discard them and to publish here only such gage heights and discharge measurements as could be reduced to a common datum and on which reliance can be placed as giving a correct estimate of the discharge.

As originally placed the gage was located in the third span of the bridge from the north shore. The next year (1896) the wire became rusted and broke frequently, and a new wire gage was placed in the east side of the first span of the bridge, but it was referred to a different datum. During 1897 there was a further change in the length of the gage, which was not recorded, and therefore it has been necessary to discard the records during those two years—that is, 1896 and 1897.

On January 25, 1898, the gage wire was compared with the bench mark, and the observations since that date have been referred to this datum. The bench mark to which the gage has been referred is a copper bolt in a large capstone on the lower wing wall of the north abutment, about 10 feet from the north end of the first iron truss, and 41.30 feet above the datum of the gage. The length of the cable of the wire gage is 44.22 feet. The measurements of 1895 are considered correct within themselves, but there was a difference between the datum of that gage and that of the present standard of 0.4 foot, making it necessary to deduct that amount from the gage readings of 1895 in order to reduce them to the present datum.

On September 2, 1902, a standard chain-and-weight gage was installed at this station to take the place of the wire gage then in use, and is referred to a horizontal scale board graduated to feet and tenths, inclosed in lock box, which is secured by bolts to the end rail of the lower side of the bridge near the left bank. The length of the chain from the zero to the extreme end of the weight is 44.22 feet.

Daily gage height, in feet, of Potomac River at Point of Rocks, Md.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	11.70	3.70	22.50	5.70	2.70	1.80	1.70	1.70	1.00	1.20	1.00	2.70
2	7.20	3.50	29.00	5.00	2.60	1.80	1.80	1.60	.90	1.20	1.00	2.80
3	5.60	3.30	16.10	4.50	2.60	1.70	1.90	1.90	.90	1.10	1.00	2.90
4	4.80	3.20	10.20	4.10	2.60	1.60	1.90	1.90	.90	1.00	1.00	3.40
5	4.20	2.80	8.10	4.00	2.50	1.60	1.80	2.00	.90	1.10	1.00	5.50
6	3.80	2.40	6.70	3.80	2.50	1.50	1.80	1.80	.90	1.20	1.00	4.40
7	3.50	2.50	5.80	4.00	2.50	1.50	1.70	1.70	.80	1.20	.90	4.20
8	3.20	2.60	6.70	6.45	2.40	1.50	1.70	1.70	.80	1.10	.90	4.00
9	3.10	2.50	7.40	16.40	3.10	1.40	1.60	1.60	.80	1.10	.90	3.80
10	3.00	2.50	8.50	14.30	2.70	1.40	1.60	1.50	.80	1.10	.90	3.50
11	2.80	3.50	12.00	12.90	2.50	1.40	1.60	1.40	.80	1.10	.90	3.20
12	2.70	4.00	12.40	12.20	2.30	1.40	1.50	1.30	.80	1.40	.90	3.60
13	2.50	4.20	14.00	11.50	2.20	1.30	1.50	1.30	.70	1.60	1.00	4.90
14	2.30	4.40	13.80	9.30	2.10	1.40	1.50	1.20	.70	1.90	1.00	7.20
15	2.10	5.20	12.00	7.80	2.10	1.40	1.40	1.20	.70	2.00	1.00	6.80
16	2.10	5.40	10.20	6.50	2.00	1.40	1.40	1.20	.70	2.10	1.00	5.70
17	2.10	5.50	8.20	5.90	1.90	1.30	1.30	1.20	.70	2.00	1.00	7.20
18	2.10	5.20	10.60	5.30	1.90	1.30	1.30	1.20	.70	1.80	1.00	9.90
19	2.10	4.80	8.70	4.90	1.90	1.30	1.30	1.20	.70	1.60	1.00	8.00
20	2.10	4.50	6.60	4.60	2.60	1.30	1.30	1.20	.70	1.40	1.00	5.90
21	2.30	4.50	5.50	4.00	2.00	1.30	1.30	1.10	.70	1.20	.90	5.20
22	3.00	5.00	4.50	3.50	2.00	1.30	1.40	1.10	.70	1.10	.90	4.80
23	6.70	7.00	4.10	3.30	1.90	1.30	1.40	1.10	.70	1.00	.90	5.00
24	5.20	4.10	3.80	3.00	1.90	1.30	1.30	1.10	.70	.90	.90	5.20
25	3.20	4.40	3.60	2.90	1.90	1.20	1.20	1.20	.90	.90	1.30	4.80
26	3.00	17.75	3.50	2.80	2.00	1.40	1.20	1.20	.80	.90	1.50	4.20
27	3.50	26.90	3.50	2.90	2.20	1.50	1.10	1.10	.80	.80	1.90	3.60
28	5.20	19.00	3.60	2.80	2.00	1.40	1.10	1.10	.80	1.00	3.00	3.50
29	5.00	.....	3.70	2.70	1.90	1.40	1.10	1.20	.80	1.00	3.50	3.00
30	4.50	.....	4.30	2.70	1.90	1.40	1.70	1.10	1.00	1.10	2.80	2.60
31	4.20	.....	6.40	.....	1.90	.....	1.80	1.00	.....	1.10	.....	2.80

Rating table for Potomac River at Point of Rocks, Md., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.2	455	2.6	8,835	5.0	22,700	7.4	40,275
.4	570	2.8	9,870	5.2	24,040	7.6	41,935
.6	900	3.0	10,925	5.4	25,380	7.8	43,610
.8	1,356	3.2	11,990	5.6	26,720	8.0	45,290
1.0	1,906	3.4	13,075	5.8	28,080	8.5	49,490
1.2	2,556	3.6	14,180	6.0	29,485	9.0	53,690
1.4	3,286	3.8	15,305	6.2	30,920	9.5	57,940
1.6	4,106	4.0	16,450	6.4	32,410	10.0	62,190
1.8	5,005	4.2	17,620	6.6	33,930	10.5	66,440
2.0	5,925	4.4	18,830	6.8	35,460	11.0	70,690
2.2	6,855	4.6	20,080	7.0	37,000		
2.4	7,825	4.8	21,370	7.2	38,615		

Estimated monthly discharge of Potomac River at Point of Rocks, Md.

[Drainage area, 9,654 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	76,640	6,385	19,079	1.98	2.28
February	205,840	7,825	31,942	3.31	3.44
March	223,690	13,625	54,746	5.67	6.54
April	116,590	9,350	32,232	3.34	3.73
May	11,455	5,465	7,072	.73	.84
June	5,005	2,556	3,413	.35	.39
July	5,465	2,221	3,706	.38	.44
August	5,925	1,906	3,210	.33	.38
September	1,906	1,122	1,351	.14	.16
October	6,385	1,356	2,906	.30	.35
November	13,625	1,616	3,011	.31	.35
December	61,340	8,835	21,382	2.22	2.56
The year	223,690	1,122	15,338	1.59	21.46

MONOCACY RIVER NEAR FREDERICK, MD.

Monocacy River rises in the south-central part of Pennsylvania and flows in a southerly direction through Frederick County, Md., entering Potomac River near the Montgomery County line. A station was established by E. G. Paul, August 4, 1896, at the county iron bridge on the turnpike, 4 miles northeast of Frederick, on the road leading from Frederick to Mount Pleasant, Md., and about 2,000 feet above the mouth of Israel Creek and 3,000 feet below the mouth of Tuscarora Creek, as shown on the Frederick atlas sheet. The drainage area is 665 square miles at this point and 1,000 square miles at the mouth. The gage is attached to the floor timber on the lower side of the bridge. The length of the wire is 35.20 feet. The bench mark is a cross cut in the top face of the capstone on the lower retaining wall of the bridge abutment on the right bank of the stream, and is 29.17 feet above gage datum.

On September 3, 1902, the wire gage in use at this station was replaced by a standard chain and weight gage, referred to a horizontal scale board graduated to feet and tenths, inclosed in a lock box, which is secured to the floor timber on the lower side of the bridge 100 feet from the right bank, by lag bolts. The length of the chain from the zero to the extreme end of the weight is 35.20 feet.

The stream at this station has two channels, being divided by a small, low island, which serves as a foundation for the middle pier of the bridge. The right channel is measured from the lower side of the bridge, and the left channel from the upper side, as these sections are freer from rocks than a continuous section on either side of the bridge. The stream is subject to high water and sudden floods, owing to the character of its upper watershed. The observer is E. L. Derr, a farmer near Frederick, Md.

The following discharge measurement was made during 1902 by E. G. Paul:

September 4: Gage height, 374 feet; discharge, 100 second-feet.

Daily gage height, in feet, of Monocacy River near Frederick, Md.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	8.50	5.90	25.20	7.00	5.20	4.30	6.90	5.20	3.70	4.60	5.10	9.50
2	8.20	5.90	14.50	6.90	5.10	4.30	6.40	4.50	3.70	6.00	5.00	7.90
3	7.10	5.90	10.90	10.50	5.10	4.30	4.90	4.20	3.70	5.10	4.90	16.00
4	6.00	8.50	10.20	8.50	5.00	4.20	4.80	4.10	3.70	4.20	4.70	8.60
5	7.90	8.50	9.60	8.30	4.90	4.20	4.80	4.10	3.90	4.50	4.60	8.20
6	8.20	8.10	9.20	8.00	4.90	4.10	4.80	4.20	3.70	7.10	4.50	7.90
7	8.10	7.90	9.10	7.90	4.80	4.10	4.80	4.20	3.60	5.20	4.40	7.80
8	7.50	7.80	8.90	7.50	4.80	4.10	4.60	4.10	3.60	5.10	4.60	7.80
9	5.90	7.40	9.90	17.90	4.70	4.10	4.50	4.00	3.60	5.00	4.50	7.50
10	5.50	6.90	15.20	16.90	4.70	4.10	4.40	4.00	3.60	4.90	4.50	7.40
11	5.40	6.50	15.50	8.20	4.70	4.10	4.30	4.00	3.60	5.50	4.50	7.90
12	5.40	6.50	12.20	7.50	4.60	4.00	4.20	4.00	3.52	12.80	4.40	9.20
13	5.30	6.50	14.50	7.30	4.60	7.10	4.10	3.90	3.50	8.10	4.40	11.50
14	5.30	6.30	10.10	6.90	4.60	5.50	4.00	3.90	3.50	6.50	4.40	9.50
15	5.20	6.10	10.00	6.50	4.60	4.20	4.00	3.80	3.50	5.10	4.30	8.20
16	5.10	5.90	9.50	6.30	4.60	4.20	3.90	3.80	3.50	4.90	4.20	15.30
17	4.90	5.90	14.60	6.10	4.50	4.20	3.90	3.80	3.50	4.70	4.20	14.50
18	4.90	5.90	10.20	5.90	4.50	4.10	3.90	3.80	3.50	4.60	4.20	8.50
19	4.90	5.90	8.40	5.80	4.50	4.10	4.10	3.80	3.50	4.50	4.60	8.20
20	4.90	6.10	8.10	5.70	4.50	4.10	4.10	3.80	3.60	4.40	4.50	9.50
21	7.20	10.20	7.90	5.60	4.50	4.20	5.20	3.70	3.60	4.30	4.40	10.50
22	18.05	14.40	7.40	5.50	4.50	4.20	4.30	3.70	3.60	4.20	4.30	17.10
23	7.10	9.60	7.10	5.40	4.50	4.10	4.20	3.70	3.50	4.20	4.20	14.20
24	6.90	9.40	6.90	5.30	4.40	4.10	4.10	3.60	3.50	4.20	4.20	8.40
25	6.10	10.50	6.50	5.30	4.40	4.10	4.10	3.60	3.80	4.10	4.20	7.50
26	6.90	24.03	6.30	5.20	4.40	5.90	4.00	3.60	4.00	4.10	5.90	7.20
27	11.15	21.40	6.00	5.10	4.50	5.60	4.00	3.60	9.10	4.10	9.40	6.90
28	7.50	19.35	6.00	5.00	4.50	5.10	3.90	4.10	5.10	13.70	7.90	6.50
29	6.90	.....	5.90	5.20	4.40	4.50	3.90	3.90	4.90	9.50	5.90	6.40
30	6.50	.....	5.60	5.20	4.30	4.50	4.50	3.70	4.80	5.50	5.90	6.20
31	6.20		6.20	.....	4.30	.....	5.50	3.70	.....	5.30	.....	5.50

Rating table for Monocacy River near Frederick, Md., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.6	45	6.2	1,192	10.0	4,460	16.5	10,050
3.8	90	6.4	1,364	10.5	4,890	17.0	10,480
4.0	150	6.6	1,536	11.0	5,320	17.5	10,910
4.2	210	6.8	1,708	11.5	5,750	18.0	11,340
4.4	270	7.0	1,880	12.0	6,180	18.5	11,770
4.6	340	7.2	2,052	12.5	6,610	19.0	12,200
4.8	420	7.4	2,224	13.0	7,040	19.5	13,060
5.0	500	7.6	2,396	13.5	7,470		
5.2	600	7.8	2,568	14.0	7,900		
5.4	700	8.0	2,740	14.5	8,330		
5.6	800	8.5	3,170	15.0	8,760		
5.8	900	9.0	3,600	15.5	9,190		
6.0	1,020	9.5	4,030	16.0	9,620		

Estimated monthly discharge of Monocacy River near Frederick, Md.

[Drainage area, 665 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	11,283	460	1,918	2.88	3.32
February	16,500	960	3,645	5.48	5.71
March	17,532	800	4,398	6.61	7.62
April	11,254	500	2,206	3.32	3.70
May	600	240	358	.54	.62
June	1,966	180	338	.51	.57
July	1,794	120	351	.53	.61
August	600	45	137	.21	.24
September	3,686	27	215	.32	.36
October	7,642	180	1,135	1.71	1.97
November	3,944	210	567	.85	.95
December	10,566	750	3,835	5.77	6.65
The year	17,532	27	1,592	2.39	32.32

JAMES RIVER BASIN.

James River, like the Potomac, rises among mountain ridges, having a general northeasterly and southwesterly trend, the tributaries flowing along narrow valleys and finally uniting to cut the mountains transversely, the waters escaping in a southeasterly direction toward the sea. The main stream is formed by the junction of Jackson and Cowpasture rivers, both of these rising in the central part of the western border of Virginia. The river and the water powers along it are fully described by Prof. George F. Swain in his report of the Water Powers of the Middle Atlantic Watershed, pages 13–33, contained in Vol. XVI of the Tenth Census.

Records of measurements have been kept as in previous years on North (of James) River at Glasgow, Va.; on James River at Buchanan, Va., Holcomb Rock, Va., and at Cartersville, Va., and on the Appomattox River at Mattoax, Va.

The description of the stations, together with the records for 1902, are given in the following pages.

NORTH (OF JAMES) RIVER AT GLASGOW, VA.

This river rises on the western slope of the Shenandoah Mountains, and flows in a southeasterly direction across the valley between the Shenandoah and Blue Ridge ranges, emptying into James River about 17 miles south of Lexington, Va. Its drainage basin is largely under cultivation, except in the upper part, where it is mountainous and covered with forest growth. This station was established at the East Glasgow County bridge, about 1 mile above the mouth of North River, by C. C. Babb and D. C. Humphreys, on August 21, 1895. The height of water is observed by means of a wire gage, the board being placed on the guard rail on the lower side of the bridge, and graduated in feet and tenths. This gage is referred to a bench mark at the top of the top chord of the bridge over the gage pulley at an elevation of 32.24 feet. The distance from the end of the weight to the marker of the gage is 27.86 feet. The measurements of discharge are made from the bridge, the initial point for soundings being on the left bank. The channel is straight for about 600 feet above and below the station; the current rather sluggish, but with sufficient velocity for measurements. There is a dam on the North River 10 miles above the station, but its influence on the flow is scarcely noticeable. The right bank is high, but the left bank is subject to overflow in very high water. The bed is of rock and gravel and fairly permanent. The observer is B. G. Baldwin, a merchant of Glasgow, Va.

The following discharge measurements were made during 1902 by D. C. Humphreys:

June 25: Gage height, 1.90 feet; discharge, 907 second-feet.
July 10: Gage height, 0.83 feet; discharge, 201 second-feet.
August 20: Gage height, 0.61 feet; discharge, 132 second-feet.

Daily gage height, in feet, of North (of James) River at Glasgow, Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	5.20	3.00	9.00	2.85	1.40	1.00	1.30	1.05	0.50	0.65	0.60	1.90
2	4.60	2.70	4.85	2.55	1.35	1.00	1.15	[a]1.00	.51	.60	.55	2.20
3	3.30	2.70	4.15	2.20	1.50	.98	.95	1.00	.50	[b].60	.70	2.40
4	2.65	2.60	3.60	2.10	1.50	.98	.85	.95	.51	[b].65	.70	2.80
5	2.55	2.45	3.45	2.00	1.48	.95	.82	.95	.51	1.12	.65	2.75
6	2.45	2.25	3.00	2.00	1.48	.95	.80	.90	.50	1.35	.55	2.15
7	2.20	2.15	2.80	2.50	1.45	.90	.80	.90	.50	.95	.60	1.90
8	2.10	2.00	2.80	2.85	1.45	.90	.80	.85	.50	.75	.70	1.85
9	2.00	1.85	3.85	3.75	1.50	.90	.80	.85	.52	.70	.72	1.80
10	1.90	1.65	4.90	3.85	1.40	.90	.78	.80	.50	.70	.72	1.60
11	1.82	1.60	4.00	3.50	1.35	.90	.75	.80	.50	.70	.70	1.50
12	1.70	1.58	3.60	3.30	1.30	1.00	.75	.75	.50	1.40	.70	1.50
13	1.65	1.52	4.00	3.80	1.28	2.25	.72	.75	.50	1.20	.65	1.60
14	1.60	1.50	3.50	3.00	1.25	1.30	.70	.70	.50	1.00	.65	1.60
15	1.55	1.50	3.15	2.35	1.25	1.15	.68	.70	.51	.90	.65	2.00
16	1.52	1.45	3.00	2.25	1.20	1.12	.65	.70	.50	.85	.70	2.60
17	1.50	1.42	3.50	2.20	1.15	1.10	.65	.70	.50	.80	1.10	4.30
18	1.45	1.50	3.00	2.10	1.12	1.05	.62	.70	.50	.75	1.00	3.10
19	1.42	1.45	2.65	2.00	1.10	1.00	.62	.70	.50	.72	.95	2.60
20	1.40	1.40	2.45	1.90	1.25	1.00	.60	.61	.50	.70	.90	2.20
21	1.45	2.30	2.40	1.80	1.15	.95	.60	.55	.50	.62	.85	2.00
22	1.50	2.10	2.35	1.75	1.10	.95	.58	.50	.52	.58	.80	2.00
23	1.45	1.49	2.30	1.70	1.10	.92	.58	.50	.55	.65	.80	1.85
24	1.48	2.50	2.25	1.65	1.10	.92	.55	.51	.50	.58	.80	1.75
25	1.42	10.20	2.20	1.60	1.10	1.90	.58	.50	.56	.55	.80	1.60
26	2.60	7.50	2.10	1.55	1.15	1.15	.60	.52	.60	.52	1.80	1.60
27	3.90	5.60	2.00	1.50	1.10	1.15	.60	.52	.60	.62	2.20	1.50
28	4.10	12.58	1.90	1.48	1.08	1.10	.60	.51	.60	.72	1.80	1.45
29	3.50	.....	1.85	1.45	1.08	1.10	.62	.50	.57	.75	1.90	1.40
30	3.25	.....	2.15	1.40	1.05	1.10	.70	.50	.56	.80	2.10	1.40
31	3.00	.....	3.30	.....	1.05	.....	1.18	.51	.....	.79	.....	1.30

[a] Interpolated August 2 to 19, inclusive. [b] Interpolated.

Rating table for North (of James) River at Glasgow, Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.0	25	2.2	1,260	4.4	4,860	7.5	11,145
.2	50	2.4	1,500	4.6	5,239	8.0	12,170
.4	100	2.6	1,770	4.8	5,628	8.5	13,195
.6	150	2.8	2,050	5.0	6,030	9.0	14,220
.8	200	3.0	2,350	5.2	6,438	10.0	16,270
1.0	270	3.2	2,760	5.4	6,846	11.0	18,320
1.2	380	3.4	3,090	5.6	7,254	12.0	20,370
1.4	500	3.6	3,430	5.8	7,662	13.0	22,420
1.6	660	3.8	3,770	6.0	8,070	14.0	24,470
1.8	840	4.0	4,130	6.5	9,095		
2.0	1,020	4.2	4,490	7.0	10,120		

Estimated monthly discharge of North (of James) River at Glasgow, Va.

[Drainage area, 831 square miles.]

Month	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	6,438	500	1,666	2.00	2.31
February	13,400	500	2,628	3.16	3.29
March	14,220	885	2,881	3.47	4.00
April	3,860	500	1,519	1.83	2.04
May	580	297	419	.50	.58
June	1,320	235	340	.41	.46
July	440	137	194	.23	.27
August	297	125	181	.22	.25
September	150	125	129	.15	.17
October	500	125	210	.25	.29
November	1,260	137	324	.39	.44
December	4,680	440	1,140	1.37	1.58
The year	14,220	125	969	1.16	15.68

JAMES RIVER AT BUCHANAN, VA.

This river rises in the Allegheny Mountains, on the western border of Virginia, and flows in an easterly direction across the State into Chesapeake Bay. The upper part of its drainage area is mountainous and largely covered with forests, while in the eastern part of the State the river flows through a flat and cultivated area. Measurements of flow are made at Buchanan, in Botetourt County, and at Cartersville, 50 miles above Richmond. The station at Buchanan was established by C. C. Babb and D. C. Humphreys, August 18, 1895. It is about 20 miles above the mouth of North River and one-half mile above the mouth of Purgatory Creek, as shown on the Natural Bridge topographic atlas sheet. The area as far as this point is mapped on the Natural Bridge, Staunton, Monterey, Lewisburg, Dublin, Christiansburg, and Roanoke sheets. The United States Weather Bureau had maintained a gage here for about two years before measurements were made by the Geological Survey. The wire gage is suspended from the steel highway bridge, which crosses the river on two spans. On April 3, 1897, the zero of this gage was lowered 2 feet to avoid negative readings. The gage is referred to a scale divided into feet and tenths, and to two bench marks. First, the top of the upper end of the third floor beam from left bank is 30 feet above the zero of the

gage. Second, the top of a stone post under the southwest corner of the porch of the Chesapeake and Ohio Railroad passenger station is 24.68 feet above zero of gage. A third bench mark is on a permanent ledge of rock on the left bank about 500 feet above the bridge, and at an elevation of 17.48 feet above the zero of the gage. The initial point of soundings is on the left bank, upper side of the bridge, marked with the end pin of the truss. The channel is straight, the flow fairly swift, and without obstructions. The bed is rocky; banks high and not subject to overflow. The observer is U. H. Hyde, a telegraph operator for the Chesapeake and Ohio Railroad, at Buchanan, Va.

The following discharge measurements were made during 1902 by D. C. Humphreys:

July 19: Gage height, 2.12 feet; discharge, 519 second-feet.
August 25: Gage height, 1.90 feet; discharge, 365 second-feet.

Daily gage height, in feet, of James River at Buchanan, Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	7.35	6.15	19.05	5.40	3.00	2.60	3.15	2.20	2.00	2.20	2.10	3.80
2	6.20	5.80	9.05	4.95	3.00	2.60	2.85	2.45	2.00	2.20	2.10	4.55
3	5.40	5.70	7.50	4.65	3.00	2.60	2.65	2.40	2.00	2.20	2.10	5.25
4	4.95	5.45	6.25	4.50	3.00	2.60	2.50	2.40	2.00	2.20	2.10	5.35
5	4.55	5.00	5.60	4.60	3.00	2.50	2.50	2.30	2.00	2.65	2.10	5.00
6	4.25	4.50	5.25	4.50	2.90	2.50	2.40	2.30	2.00	2.55	2.10	5.10
7	4.05	4.20	5.00	4.50	2.90	2.50	2.40	2.30	2.00	2.35	2.00	4.40
8	3.90	3.95	5.20	5.00	2.90	2.50	2.30	2.30	1.90	2.20	2.00	3.95
9	3.80	3.85	6.30	5.90	2.90	2.40	2.40	2.20	1.90	2.10	2.00	3.65
10	3.65	3.70	7.10	5.80	2.90	2.40	2.50	2.20	1.90	2.10	2.00	3.45
11	3.50	3.60	6.60	5.75	2.90	2.40	2.50	2.20	1.90	2.25	2.00	3.30
12	3.40	3.50	6.55	5.55	2.80	2.50	2.40	2.10	1.90	2.45	2.00	3.20
13	3.30	3.40	6.70	5.25	2.80	2.80	2.40	2.10	1.90	2.50	2.00	3.20
14	3.15	3.30	8.00	4.90	2.80	3.10	2.30	2.10	1.90	2.50	2.00	4.25
15	3.00	3.20	7.50	4.45	2.80	2.95	2.30	2.20	1.90	2.40	2.00	4.45
16	3.00	3.20	7.05	4.25	2.70	2.80	2.30	2.30	1.90	2.40	2.00	4.45
17	3.00	3.20	8.65	4.05	2.70	2.70	2.20	2.20	1.90	2.30	2.00	6.35
18	3.00	3.10	7.40	3.90	2.70	2.60	2.10	2.20	1.90	2.30	2.05	6.10
19	3.00	3.10	5.95	3.80	2.70	2.50	2.10	2.10	1.90	2.20	3.30	4.95
20	2.90	3.20	5.35	3.70	2.70	2.40	2.10	2.10	1.90	2.10	2.85	4.30
21	2.90	3.30	4.90	3.60	2.70	2.40	2.10	2.10	1.90	2.10	2.55	3.95
22	2.90	3.50	4.55	3.50	2.60	2.40	2.10	2.00	1.90	2.10	2.40	4.15
23	2.90	3.75	4.25	3.40	2.60	2.40	2.10	2.00	1.90	2.10	2.30	4.25
24	2.90	4.20	4.10	3.40	2.70	2.40	2.10	2.00	1.90	2.10	2.20	3.95
25	2.90	10.10	4.00	3.30	2.70	2.40	2.10	2.00	1.90	2.00	2.45	3.75
26	3.30	14.40	3.85	3.30	2.80	3.00	2.10	2.00	2.05	2.00	3.80	3.65
27	5.05	9.55	3.70	3.20	2.90	2.90	2.10	2.00	2.10	2.00	4.55	3.25
28	8.40	15.35	3.70	3.10	2.90	2.80	2.10	2.00	2.15	2.30	4.10	3.00
29	6.15	.....	5.60	3.10	2.80	2.80	2.10	2.00	2.30	2.30	3.50	3.25
30	5.70	.....	8.05	3.10	2.80	2.90	2.10	2.00	2.30	2.20	3.15	3.15
31	6.55	.....	6.20	.....	2.70	.....	2.20	2.00	.....	2.20	.....	3.00

Rating table for James River at Buchanan, Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.6	310	4.8	4,640	8.0	12,620	16.0	33,740
1.8	360	5.0	5,060	8.5	13,940	16.5	35,060
2.0	430	5.2	5,495	9.0	15,260	17.0	36,380
2.2	540	5.4	5,950	9.5	16,580	17.5	37,700
2.4	670	5.6	6,425	10.0	17,900	18.0	39,020
2.6	840	5.8	6,911	10.5	19,220	18.5	40,340
2.8	1,050	6.0	7,403	11.0	20,540	19.0	41,660
3.0	1,330	6.2	7,903	11.5	21,860	19.5	42,980
3.2	1,650	6.4	8,411	12.0	23,180	20.0	44,300
3.4	1,980	6.6	8,927	12.5	24,500	20.5	45,620
3.6	2,330	6.8	9,452	13.0	25,820	21.0	46,940
3.8	2,690	7.0	9,980	13.5	27,140	21.5	48,260
4.0	3,050	7.2	10,508	14.0	28,460	22.0	49,580
4.2	3,440	7.4	11,036	14.5	29,780	22.5	50,900
4.4	3,840	7.6	11,564	15.0	31,100		
4.6	4,240	7.8	12,092	15.5	32,420		

Estimated monthly discharge of James River at Buchanan, Va.

[Drainage area, 2,058 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	13,676	1,180	3,666	1.78	2.05
February	31,954	1,490	6,157	2.99	3.11
March	41,794	2,510	8,730	4.24	4.89
April	7,156	1,490	3,335	1.62	1.81
May	1,330	840	1,083	.53	.61
June	1,490	670	877	.43	.48
July	1,570	480	634	.31	.36
August	710	430	516	.25	.29
September	600	390	422	.21	.23
October	890	430	573	.28	.32
November	4,140	430	951	.46	.51
December	8,283	1,330	3,434	1.67	1.93
The year	41,794	390	2,532	1.23	16.59

JAMES RIVER AT CARTERSVILLE, VA.

Observations of the height of James River are made by the Weather Bureau at Lynchburg, Va., 48 miles below Buchanan and about 100 miles above Cartersville. The drainage area is given as 3,700 square miles. The gage is on the first pier of the Amherst bridge, at the foot of Ninth street, on the side facing Lynchburg, about 100 feet from the shore. The elevation is 494.7 feet above mean sea level. The highest water was about 27 feet on September 30, 1870, and the lowest —0.3 feet on September 12–15, 1895.

Gages were established on James River in 1893 by F. B. Isaacs, engineer for water power of the Chesapeake and Ohio Railway Company, at Ninemile Locks, Columbia, Scottsville, Lynchburg, Balcony Falls, Buchanan, Eagle Mountain, and Clifton Forge. Records of heights of water at these points were made twice daily from 1893 to 1897, and freshet reports were obtained for these years. The gages were not referred to any fixed datum, but the zero of each gage was set at what was considered ordinary low water in the river. During the latter part of 1899 records have been resumed, excepting at Scottsville, Balcony Falls, and Eagle Mountain, where the gages have been abandoned.

At Boshers dam, 9 miles above Richmond, is a gage where the height of water is recorded twice daily, showing the supposed head on the crest of dam. This crest, however, is so irregular that the coefficient of discharge has not been ascertained. Another complication exists in the fact that water is deflected into a canal, the quantity not being known.

Observations are maintained by the Weather Bureau at Richmond, Va., the gage being at the foot of Virginia street, near Fourteenth, immediately east of the Richmond and Danville Railroad bridge. It is a standard brass Weather Bureau gage embedded in the cement buttress. The elevation of the zero is 2.8 feet.

A gaging station was established January 1, 1899, by D. C. Humphreys, and is located at the highway bridge crossing the James at Cartersville, one-half mile from railroad station and 50 miles above Richmond, Va. The wire gage is attached to a horizontal gage rod fastened to the bridge and is referred to a bench mark, the top of the lower end of the fourth-floor beam from the right bank, which is 32.04 feet above the zero of the gage. The gage was verified June 23, 1899. The channel is straight for one-third of a mile above and 1 mile below the station, the current fairly swift, and the bottom somewhat sandy and shifting. The banks are high and not subject to overflow except in extreme high water. The observer is Julien I. Palmore, clerk in a store at Cartersville, Va.

The following discharge measurements were made during 1902 by D. C. Humphreys:

July 15: Gage height, 1.10 feet; discharge, 2,008 second-feet.
August 25: Gage height, 0.80 feet; discharge, 1,482 second-feet.

Daily gage height, in feet, of James River, at Cartersville, Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	16.50	7.50	22.90	8.00	3.45	1.98	1.70	1.48	0.60	1.40	1.80	9.00
2	11.20	8.00	22.05	6.40	3.10	1.70	1.55	1.30	.55	1.40	1.62	6.30
3	8.80	9.60	14.00	5.40	3.40	1.68	2.00	1.80	.52	1.40	1.52	11.40
4	7.20	8.00	10.50	5.20	3.30	1.30	1.70	2.10	.50	1.00	1.42	8.30
5	6.15	7.05	9.50	5.10	2.80	1.40	1.70	1.70	.52	7.95	1.40	10.95
6	5.55	5.50	9.20	4.70	3.40	1.30	1.40	2.15	.80	16.85	1.38	9.30
7	5.25	5.05	7.75	4.80	3.30	1.29	1.40	2.00	.75	5.60	1.70	7.15
8	5.00	4.92	7.00	7.20	3.00	1.40	1.60	1.90	.60	4.05	1.50	6.30
9	4.88	4.22	8.70	10.80	2.90	1.30	1.90	1.30	1.00	3.25	1.30	5.05
10	4.38	3.88	8.60	8.30	2.80	1.20	1.50	1.60	1.00	2.40	1.30	4.70
11	4.00	3.62	9.20	7.60	2.55	1.20	1.80	1.70	.90	1.60	1.28	3.90
12	3.68	3.50	8.80	7.10	2.40	1.35	1.42	1.00	.90	10.02	1.30	3.60
13	3.40	3.60	8.20	6.52	2.10	1.20	1.33	1.05	.88	5.72	1.32	3.50
14	3.30	3.30	8.00	5.54	2.30	1.35	1.20	1.10	.75	3.80	1.22	3.50
15	3.25	3.12	8.72	5.31	2.00	1.30	1.00	1.30	.70	2.80	1.20	3.50
16	3.00	3.10	7.90	5.10	2.00	2.50	1.00	4.25	.60	2.20	1.28	4.50
17	2.95	3.10	10.70	4.50	2.20	14.35	1.00	3.15	.55	2.05	1.29	8.50
18	2.90	2.82	10.05	4.40	2.15	4.70	1.00	1.45	.53	1.87	3.50	7.55
19	2.88	2.60	9.80	4.35	2.10	3.10	1.00	1.25	.50	1.72	4.22	8.10
20	2.72	2.70	7.72	4.05	1.90	2.13	1.22	1.20	.50	1.65	3.28	6.20
21	2.72	3.10	6.70	3.20	2.38	1.88	1.32	1.00	.60	1.60	2.52	5.30
22	7.15	7.70	6.20	3.60	2.40	1.72	1.30	1.15	1.00	1.52	2.40	6.30
23	6.12	7.70	5.50	3.50	2.00	1.60	1.20	1.10	.70	1.42	2.20	6.15
24	4.30	7.00	5.20	3.40	3.00	1.60	1.10	.90	.60	1.35	1.90	5.30
25	3.60	10.20	4.70	3.30	3.40	1.58	1.00	.90	.70	1.80	2.30	4.60
26	3.30	21.90	4.50	3.20	3.50	2.00	.92	.80	2.00	1.28	9.35	4.20
27	5.72	19.20	4.20	3.10	2.40	2.30	.88	.82	4.35	1.20	6.20	3.75
28	9.44	17.28	3.90	2.90	2.20	2.00	.80	.70	1.75	6.11	5.30	3.20
29	10.10	.....	5.20	3.00	2.20	1.78	.78	.80	1.35	4.00	5.00	3.10
30	8.00	.....	7.20	3.80	2.10	1.80	.65	.70	1.40	2.30	5.15	3.08
31	7.80	.....	9.40	.....	2.00	.....	1.62	.65	.....	2.00	.....	3.05

Rating table for James River at Cartersville, Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.4	702	4.0	7,600	7.6	18,380	16.0	46,100
.6	1,000	4.2	8,100	7.8	19,040	16.5	47,750
.8	1,296	4.4	8,610	8.0	19,700	17.0	49,400
1.0	1,600	4.6	9,130	8.5	21,350	17.5	51,050
1.2	1,916	4.8	9,660	9.0	23,000	18.0	52,700
1.4	2,243	5.0	10,200	9.5	24,650	18.5	54,350
1.6	2,582	5.2	10,760	10.0	26,300	19.0	56,000
1.8	2,932	5.4	11,330	10.5	27,950	19.5	57,650
2.0	3,294	5.6	11,910	11.0	29,600	20.0	59,300
2.2	3,672	5.8	12,500	11.5	31,250	20.5	60,950
2.4	4,063	6.0	13,100	12.0	32,900	21.0	62,600
2.6	4,463	6.2	13,760	12.5	34,550	21.5	64,250
2.8	4,871	6.4	14,420	13.0	36,200	22.0	65,900
3.0	5,300	6.6	15,080	13.5	37,850	22.5	67,550
3.2	5,740	6.8	15,740	14.0	39,500	23.0	69,200
3.4	6,190	7.0	16,400	14.5	41,150	24.0	72,500
3.6	6,650	7.2	17,060	15.0	42,800	25.0	75,800
3.8	7,120	7.4	17,720	15.5	44,450		

Estimated monthly discharge of James River at Cartersville, Va.

[Drainage area, 6,232 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	47,750	4,666	12,814	2.06	2.38
February	65,570	4,463	16,494	2.65	2.76
March	68,870	7,360	22,368	3.59	4.14
April	28,940	5,083	10,966	1.76	1.96
May	6,420	3,111	4,516	.72	.83
June	40,655	1,916	4,231	.68	.76
July	3,294	1,974	2,077	.33	.38
August	8,225	1,074	2,374	.38	.44
September	8,480	850	1,579	.25	.28
October	48,905	1,916	7,078	1.14	1.31
November	24,155	1,916	4,918	.79	.88
December	30,920	5,410	15,048	2.39	2.41
The year	68,870	850	8,539	1.37	18.53

JAMES RIVER AT HOLCOMBS ROCK, VA.

This station was established by the Willson Aluminum Company, of Holcombs Rock, Va., in 1899, in connection with measurements to determine the horsepower available at that point. During 1899 the records were fragmentary, but at the commencement of 1900 daily records were taken, which have been furnished to the Geological Survey through the courtesy of George O. Seward, general manager of the company. The gage consists of a copper float 8 by 8 by 8 inches, with a vertical rod 1½ inches square attached to it, the rod, which extends up through the powerhouse floor, being graduated to tenths of a foot. The copper float is inclosed in a 12-inch by 12-inch by 12-foot box, which rests solidly on the bottom of the river. The box is perforated, so that the water in it will always stand at the same level as the water in the river, while the float, being inclosed, is not in danger of being broken by floating timber. The fluctuations of the river are read directly from the rod, which moves up or down with the float as it responds to the variations in the height of the river. Measurements of discharge are not made at this point.

Daily gage height, in feet, of James River at Holcombs Rock, Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	9.50	5.80	19.00	.....	1.90	1.60	1.80	1.15	0.90	1.35	0.80	2.60
2	7.50	5.25	16.40	.....	1.80	1.50	1.45	1.20	.90	1.55	.90	3.45
3	5.50	5.80	8.10	.....	1.95	1.50	1.30	1.00	.90	2.05	.85	4.25
4	4.75	5.15	6.05	.....	1.90	1.40	1.20	1.15	.90	2.25	.90	4.90
5	4.00	4.10	5.10	.....	2.00	1.40	1.20	1.10	.90	2.25	.95	4.70
6	3.55	3.70	4.50	.....	1.80	1.40	1.20	1.20	.90	2.10	1.15	4.65
7	3.28	3.35	4.35	.....	1.80	1.30	1.25	1.20	.90	1.55	1.05	3.65
8	3.10	3.20	4.80	.....	2.00	1.30	1.00	1.10	.90	1.10	1.00	3.00
9	2.85	3.05	5.85	.....	2.00	1.30	1.20	.95	.90	1.15	1.15	2.55
10	2.75	2.55	7.20	.....	1.80	1.20	1.15	.45	.90	1.10	1.25	2.30
11	2.60	2.35	6.80	.....	1.80	1.20	1.25	.95	.85	1.05	1.05	2.10
12	2.45	2.30	6.40	.....	1.70	1.20	1.10	.80	.85	1.65	.80	1.95
13	2.30	2.20	6.20	.....	1.70	1.65	1.05	.85	.85	1.90	1.00	2.05
14	2.10	2.10	6.60	.....	1.70	1.60	1.00	.95	.00	1.20	1.00	2.25
15	2.00	2.00	6.20	.....	1.60	1.50	1.10	.95	.60	1.10	.90	3.35
16	2.00	1.90	4.95	.....	1.50	1.80	1.10	1.10	.80	1.20	1.00	3.30
17	2.00	1.90	4.55	.....	1.50	1.65	.90	.55	.75	1.10	1.05	5.50
18	2.00	1.90	3.90	.....	1.50	1.35	.85	.60	.75	1.00	1.00	6.25
19	1.90	1.80	3.55	.....	1.30	1.40	.95	.95	.80	1.10	1.00	4.25
20	1.90	1.70	3.40	.....	1.30	1.35	.00	.85	.85	1.20	1.40	3.40
21	1.95	2.15	3.00	.....	1.55	1.20	1.20	.75	.00	1.15	1.55	2.80
22	2.00	2.60	3.10	.....	1.55	1.20	1.10	.75	.95	.90	1.25	2.90
23	1.95	2.70	.....	.....	1.55	1.35	1.00	.70	.80	.90	1.30	3.00
24	1.85	3.35	.....	.....	1.55	1.15	.90	.60	.85	.80	1.15	3.15
25	1.80	10.50	.....	.....	1.60	1.15	.80	.90	.85	.85	1.50	2.45
26	1.95	13.00	.....	.....	1.70	1.55	.80	.75	.85	.75	2.05	2.20
27	6.85	10.30	.....	1.90	1.70	1.60	.00	.80	.95	1.05	3.65	2.00
28	8.20	11.90	.....	1.90	1.80	1.40	1.00	.80	.55	1.10	3.05	1.95
29	6.40	.....	.....	1.90	1.65	1.50	.80	.80	1.05	1.20	2.40	1.75
30	5.10	.....	.....	1.90	1.60	1.60	.95	.90	1.10	.90	2.05	1.80
31	5.75	.....		.....	1.60	.....	1.15	.65	.....	.80	.....	1.70

APPOMATTOX RIVER AT MATTOAX, VA.

This station was established in August, 1900, at the crossing of the Southern Railway, 27 miles southwest of Richmond. The gage rod, which is on the guard rail of the bridge, is laid off to feet and tenths, graduations being indicated by brass nails. The zero of the rod is 58.1 feet from the west end of the bridge, on the upstream side. The outer rim of the pulley is 0.9 foot from the zero of the rod; the distance from the end of the weight to the pointer on the wire rope is 48.75 feet. When the gage reading is 1 foot the water level is 45.6 feet below the top surface of the upper chord of the bridge, upstream side, and at the zero of the gage.

The river here is straight for a considerable distance above the station, but there is an abrupt bend about 100 feet below the bridge. The river is very narrow, and at the low stage at which the gage was placed the current velocity is not very well distributed, there being practically no current for several feet next to the west bank. It was possible, however, to secure a good gaging, and old residents stated that the river was at the lowest stage it had reached in fourteen years. The Mattoax railroad station is located on the west bank of the river, and J. C. Carter, the station agent, is the observer.

The following measurements have been made during 1902 by B. S. Drane:

July 10: Gage height, 1.80 feet; discharge, 391 second-feet.
August 16: Gage height, 7.68 feet; discharge, 2,266 second-feet.
October 14: Gage height, 5.75 feet; discharge, 1,410 second-feet.
October 14: Gage height, 4.88 feet; discharge, 1,144 second-feet.
December 6: Gage height 13.10 feet; discharge, 4,857 second-feet.

Daily gage height, in feet, of Appomattox River at Mattoax, Va.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
1	15.50	5.90	21.00	4.00	7.00	1.60	3.10	2.00	0.60	1.60	2.50	7.40
2	22.00	5.90	16.00	3.50	4.70	1.60	3.30	4.50	.50	1.90	2.50	7.00
3	15.00	11.00	15.00	3.25	4.00	1.50	2.75	2.90	.50	2.10	2.50	10.00
4	4.75	11.50	12.00	3.10	4.00	1.50	1.80	2.00	.80	1.10	1.80	11.90
5	3.80	12.00	10.00	3.10	4.50	1.40	1.80	3.60	1.30	2.00	1.75	12.00
6	3.80	8.00	9.70	3.00	3.30	1.35	1.60	3.30	1.20	10.00	1.70	13.10
7	3.15	4.30	10.50	3.05	3.00	1.25	1.65	2.00	1.00	11.00	1.75	12.00
8	3.30	4.70	7.00	8.00	3.80	1.30	1.65	4.20	.80	11.50	1.70	10.00
9	3.20	4.30	6.00	10.50	4.20	1.30	2.90	2.70	.75	3.80	1.70	8.00
10	3.15	3.50	6.50	11.00	3.50	1.30	1.70	1.65	3.00	2.20	1.65	6.00
11	3.20	3.15	5.00	10.90	3.80	1.25	2.00	1.60	3.50	2.25	1.50	3.50
12	3.10	3.30	4.80	5.00	2.50	1.25	1.30	3.60	2.30	4.70	1.45	3.00
13	2.75	3.30	4.50	4.15	2.45	1.20	1.30	1.70	1.20	7.80	1.40	2.50
14	2.10	3.25	4.20	3.15	2.45	1.20	1.25	1.50	1.00	6.50	1.45	3.00
15	2.00	2.90	3.90	3.35	2.45	1.20	1.00	2.60	.75	3.08	1.50	3.10
16	2.70	2.90	3.70	3.50	2.50	1.20	.99	6.50	.70	2.35	1.40	3.25
17	2.70	3.10	5.20	3.40	2.20	9.00	.90	3.20	.65	2.00	1.40	2.35
18	2.50	3.00	8.00	3.20	2.95	9.50	.80	2.00	.65	1.95	5.00	7.50
19	2.45	2.95	6.20	3.20	2.20	9.50	.75	1.50	.60	1.85	9.00	6.00
20	2.40	2.65	5.30	3.10	3.00	8.00	.75	1.20	.60	1.65	8.00	4.50
21	2.35	3.00	4.50	3.00	4.15	2.60	.75	3.70	.60	1.50	5.00	3.55
22	9.00	5.00	4.00	3.00	2.30	2.00	1.00	1.50	.80	1.45	2.80	8.50
23	10.00	10.00	3.90	2.90	2.30	1.90	1.00	1.60	1.90	1.30	2.50	7.00
24	9.00	12.00	3.05	2.85	2.00	1.60	1.40	1.30	1.90	1.25	2.35	4.00
25	4.50	15.00	3.55	2.75	2.10	3.00	.90	1.10	1.20	1.35	3.00	3.50
26	4.00	18.00	3.45	2.75	2.30	3.00	.80	1.00	1.00	1.35	9.00	2.50
27	5.50	20.00	3.25	2.70	2.30	3.00	.85	1.00	2.35	1.25	9.00	2.25
28	8.20	24.00	3.15	2.65	2.00	3.00	.75	.70	1.60	1.85	10.00	2.30
29	8.00	.....	3.50	2.60	2.00	2.00	.65	.60	1.60	7.25	7.00	2.40
30	5.75	.....	5.50	3.50	1.70	3.55	1.20	.60	1.10	8.20	3.35	3.30
31	5.90	.....	5.55	.....	1.65	.....	2.20	.60	.....	3.80	.....	3.35

Rating table for Appomattox River at Mattoax, Va., for 1902.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.4	140	4.2	875	7.8	2,288	16.5	6,675
.8	180	4.4	935	8.0	2,380	17.0	6,965
1.0	200	4.6	995	8.5	2,615	17.5	7,255
1.2	224	4.8	1,065	9.0	2,850	18.0	7,555
1.4	251	5.0	1,135	9.5	3,090	18.5	7,855
1.6	282	5.2	1,205	10.0	3,330	19.0	8,170
1.8	316	5.4	1,275	10.5	3,575	19.5	8,485
2.0	350	5.6	1,345	11.0	3,820	20.0	8,815
2.2	390	5.8	1,415	11.5	4,065	20.5	9,145
2.4	430	6.0	1,490	12.0	4,310	21.0	9,490
2.6	473	6.2	1,576	12.5	4,555	21.5	9,835
2.8	519	6.4	1,662	13.0	4,805	22.0	10,195
3.0	565	6.6	1,748	13.5	5,055	22.5	10,555
3.2	615	6.8	1,834	14.0	5,315	23.0	10,930
3.4	665	7.0	1,920	14.5	5,575	24.0	11,695
3.6	715	7.2	2,012	15.0	5,845		
3.8	765	7.4	2,104	15.5	6,115		
4.0	815	7.6	2,196	16.0	6,395		

Estimated monthly discharge of Appomattox River at Mattoax, Va.

[Drainage area, 745 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	10,195	350	1,684	2.26	2.61
February	11,695	484	2,501	3.36	3.50
March	9,490	602	2,014	2.70	3.11
April	3,820	473	1,004	1.35	1.51
May	1,920	290	601	.81	.93
June	3,090	224	668	.90	1.00
July	640	165	277	.37	.43
August	1,705	160	437	.59	.68
September	690	150	246	.33	.37
October	4,065	212	934	1.25	1.44
November	3,330	251	877	1.18	1.32
December	4,855	400	1,637	2.20	2.54
The year	11,695	150	1,073	1.44	19.44

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